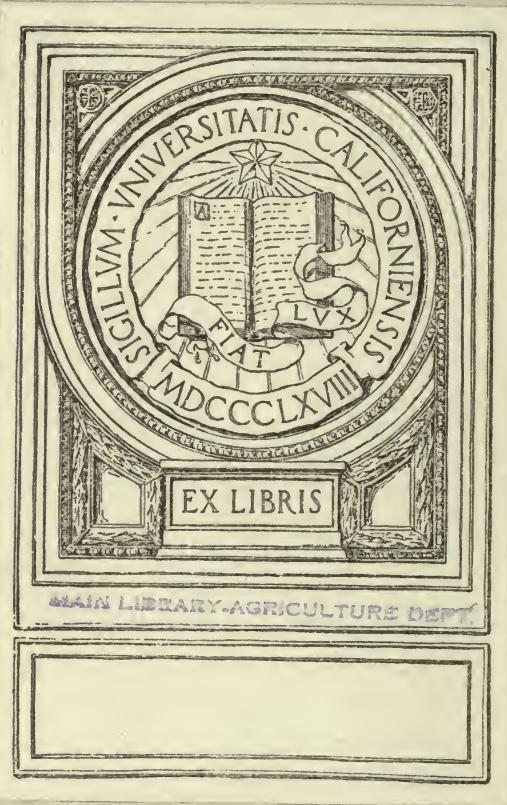


**Raw Products
of the World
AFRICA**



Raw Products
of the World

VOL. I

Africa

By RALPH DAVOL

"Author of "AMERICAN PAGEANTRY"

"TWO MEN OF TAUNTON"



DAVOL PUBLISHING COMPANY
TAUNTON, MASSACHUSETTS

HF1041

23

v.1

COPYRIGHT 1922
MAIN LIBRARY AGRICULTURE DEPT.

LOCATION OF AFRICAN PRODUCTS

563312



ACKNOWLEDGEMENT

In compiling this work the writer has had valuable clerical assistance by Ada Mixon, Clara Kretzinger, Alice M. James and Henry C. Crane. The writer has visited Africa and, during the war, was employed at the War Trade Board in research work dealing with Africa and Oriental countries.

In addition to the special reports on world resources sent by American consuls during the war the sources from which the material in this book is gathered include U. S. Commerce Reports, publications of the Philadelphia Commercial Museum, Reports of the Department of Agriculture and Geological Survey, Statesman's Year Book, British and French Consular reports, Bulletins of the Agricultural Institute of Rome, and of the Imperial Institute of Great Britain, British Board of Trade Journal, South African Year Book, publications of Royal Geographical Society, pamphlets issued by the National City Bank and Guaranty Trust Company of New York, the following magazines and newspapers: Egyptian Gazette, Capetown News, Nigeria Gazette, L'Afrique Française, African World, South African Magazine, Gordian, and such published volumes as the works of Sir Harry Johnson, of E. D. Morel, Theodore Roosevelt, C. W. Furlong, H. L. Shantz, John Hays Hammond, J. Ellis Barker and Oxford Survey of British Empire.

Ralph Davol, 1922.

Digitized by the Internet Archive
in 2007

<http://archive.org/details/rawproductsofwor00davorich>

ECONOMIC AFRICA

The area of Africa, including the islands adjacent to the coast, is given as 11,498,000 square miles. The population is approximately 150,000,000 natives and 3,000,000 European colonists located mostly on the fringe of sea-coast and around the inland rivers. Since the abolition of the slave trade and reduction of tribal wars and of plagues and epidemics, largely through the agency of missionaries, the blacks are multiplying faster than the Caucasians.

The prospect for economic development of Africa is especially good because this is the second largest continent and, lying across the equator, has products of the tropical and temperate zones at all times and the backward undeveloped races offer valuable potentialities of immediate improvement, though the continent will become agriculturalized rather than industrialized during the next few years.

Of the world's commerce, Africa has but 4½ per cent., though steadily expanding. For the year 1918 the total trade amounted to \$2,145,000,000 of which \$1,163,000,000 was with Great Britain. The United States' imports from Africa for 1913 were valued at \$2,107,812—for 1919, at \$112,187,646. The exports from the United States to Africa for 1913 were valued at \$2,790,377—for 1919, at \$18,000,000.

Africa has twice the population of South America. By educating the native to the requirements of modern civilization, his purchasing power will soon place Africa ahead of South America in world trade.

Africa is essentially a land of raw materials. At the present time many of the world's requirements come from this almost virgin territory.

The giant sea-turtle, weighing from 500 to 800 pounds, visits the **Asencion** islands every spring to lay its eggs on the sandy beach.

In the territory of **Kenya** the acreage devoted to maize is rapidly increasing—flax is well established—livestock in the highlands does well since the loss from rinderpest and tick-borne diseases is kept down by scientific control—natron and diatomite are found in large amount.

Tanganyika has immense forest areas—many large sisal plantations started by the Germans—millions of sheep and goats owned by natives; garnets are found in abundance.

Uganda is largely devoted to cotton-growing, profitably carried on by natives.

Zanzibar and **Pemba** islands supply the bulk of the world's cloves, controlled chiefly by Arabs.

Mauritius raises sugar and hemp. Copra is an increasing product of **East Africa**.

Cotton, tobacco and coffee predominate in **Nyassaland**.

On the island of **St. Helena** are found Norfolk Pines and Eucalyptus. This is still a considerable whaling port.

The **Seychelles** produce cinnamon, sugar, vanilla and cocoanuts.

Somaliland exports hides and ghee; **Basutoland** wool, mohair, wheat, mealies and kaffir corn.

Bechuanaland is a cattle-raising country.

The products of **Northern Rhodesia** are maize, cotton, tobacco, wheat and rubber. **Southern Rhodesia** has gold reefs and cattle ranges; large fruit orchards have been planted; tobacco is increasing in acreage. Irrigation projects are advancing. Chromium, asbestos and arsenic are mined.

In **Swaziland** alluvial tin is found, but this is chiefly a grazing country for cattle and sheep.

Wheat, barley, oats, maize, potatoes and kaffir corn are increasing in the **Union of South Africa**. Wool, mohair, hides ostrich feathers, have recovered from the slump of the war period. Many manufacturing plants are starting up. Gold and diamonds are main source of wealth.

Cape of Good Hope exports diamonds, wines and feathers.

Bunker coal is abundant at **Natal**, though this is not of the high Welsh standard. Tea plantations are numerous, sugar and wattle bark are large items. Whale fishing continues prosperous.

The **Transvaal** is famed for its gold mines on the Rand. Copper, tin and coal are also mined.

Orange Free State is a stock raising country. Many diamonds are exported from this territory as well as from former **German Southwest Africa**.

Palm oil and palm kernels are the principal crop of **Nigeria**. Other products are rubber, ground nuts, kola, cocoa, shea butter, ivory, capsicum pepper, hides, mahogany, sheep and goat skins. Much alluvial tin is taken out, also galena. Extensive collieries are operated at Udi.

Gambia supplies gold dust, hides, peanut and palm products.

Palm oil, cocoa, hides, ivory and kola nuts come from the **Cameroons**.

The **Gold Coast** yields many valuable woods, gold dust, cocoa, kola, manganese and palm oil.

Ashanti exports bananas, cocoa and mahogany.

From the **Ivory Coast** come pineapples, bananas, cocoa, cocoanuts, mahogany, palm products, coffee, rubber and lumber.

Dahomey yields palm oil, yams and manioc.

Olive oil is a chief product of **Tunis**, which also exports sponges, tunny, anchovies, citrus fruits, silk, dates, wheat, barley and durra, wines, almonds, pistachio, alfa, henna, cork, goat skins. Phosphates and lead are mined.

Eritrea, on the Red Sea, is noted for its pearl fisheries. Other exports are meats, hides, butter and palm nuts.

Italian Somaliland produces ghee, hides, gums, nuts, cotton and small amount of petroleum.

The main staples of **Tripoli** are olives, lemons, dates, figs, cereals, esparto, almonds, saffron, durra and barley. Sponges to the value of 16,424,250 lira were gathered in 1920.

Tripoli is the gateway to the Sahara, from which caravans of camels annually bring large amounts of gums, ostrich feathers, gold dust and ivory.

From the Portuguese islands of **San Thomé** and **Principe** come cocoa, coffee, rubber and chincona.

From **Togoland** come cotton, cocoa, kapok, cassava, copra and palm products.

Sierra Leone supplies ginger, snails, palm kernels and kola nuts.

The long-staple cotton of Egypt is famous. The Nile valley also produces wheat, maize, rice, onions, beans and eggs. Petroleum, phosphate, manganese, talc, gypsum, salt, turquoise and alabaster are mined.

Gum arabic is the great product of **Soudan**, which also yields cotton, ivory, sesame, senna, dates, durra, ebony, bamboo, castor oil, karite nuts and much cattle.

In **Algeria** the cork tree grows abundantly, also esparto, grapes, tobacco, dates, citrus fruit, figs, olives, wheat, barley, oats and flax. Silk is manufactured. Many vegetables for

French markets are raised. Sardines, tunny and sprats are exported. Sheep are raised in large flocks. Phosphates, iron, lead, zinc and sulphur are mined.

Large virgin forests are found in French Congo where wild rubber abounds. Palm oil, coffee and much live stock are found in the vicinity of Lake Chad. Salt is an important commodity.

The products of Madagascar include rice, sugar, coffee, beans, vanilla, manioc, cloves, wild rubber, wool, berry trees, raffia, silk, graphite, gold and nickel. Breeding of hump-backed Indian cattle is an important industry.

The islands of Mayotte and Commorro produce sugar cane, vanilla and rum.

Réunion yields rum, maize, coffee and manioc.

Somaliland exports salt, coffee, ivory and hides. Pearl fisheries are important.

Liberia exports coffee, piassava, chilli peppers, palm oils, kola and gold dust.

Senegal and Sahara produce ground nuts, salt, millet, rice castor beans, gums, rubber and water melons.

Hides come from Mauretania.

Rubber, wax, ground nuts, hides, wool, palm kernels, bananas come from French Guinea.

The Cape Verde islands produce medicinal herbs, cochineal, bananas, and goat skins.

Much fish for Portugal comes from Angola. Other products are wax, coffee, ivory, cocoanuts, sugar. Wild rubber is being exhausted. Petroleum and asphalt are found, also malachite and salt.

Mozambique yields salt, wax, wattle bark, hides, ivory, gold ores, sugar and cocoanuts.

Cattle and coffee are standard products of Abyssinia. Other items are wax, ghee, goat skins, durra, ivory and big game.

FUTURE OF LEADING PRODUCTS

The reefs and banques of Africa seem likely to supply between 40 and 50 per cent. of the world's supply of gold for years to come.

The De Beers Diamond Company has been called the most successful trust in the world and will probably control the market for many years in spite of the activities in the diamond fields of South America and India.

Tin mining was stimulated by the war. The large output of Nigeria and lesser amounts from South Africa, Congo and Algeria may not keep up to the war level.

Phosphates of Algeria and Tunis show no signs of giving out and will hold the lead for some time to come.

The vast Katanga copper mines are reported to have a sufficient amount of ore assaying 15 per cent. and lying on the surface of the ground to supply the entire world demand for 20 years.

Soundings for petroleum throughout the continent have not been very successful. Egypt has a steady and considerable flow. Seepages of promise are found in Algeria, Angola and Mozambique. Oil distilled from shale has a commercial value in South Africa.

The lack of fuel on this continent where labor is so plentiful and the soil so productive has prompted indefatigable efforts to discover oil in commercial quantities for operating engines.

Ivory from elephant tusks must of necessity decrease with the steady reduction of the herds. The supply of fossil ivory will naturally decrease more rapidly than ivory from slaughtered animals.

Big Game Diminishing

Notwithstanding many restrictive and protective game laws big game is diminishing. In certain localities lions and elephants have been condemned for depredations on farms and ranches.

Hides, skins and meat products are steadily increasing as the grazing lands become more generally utilized and preventives of animal diseases are more widely used. Native tribes are enlarging their flocks of sheep and cattle.

Ostrich feathers are recovering from the slump of the war but South Africa is not likely to recover its monopoly as birds are being raised successfully in Australia and Southwestern United States.

The fisheries and sponge industry of Northern Africa show little change, but whale fishing from South Africa is declining.

Outlook for Rubber

Africa was once the chief source of wild rubber. The rapid advance in the use of plantation rubber has put the Malay States and East Indies ahead of Brazil. The deadly cli-

mate of the rubber-growing regions works against Africa's ascendancy in this product.

The cotton industry is greatly expanding in many parts of Africa. Fine Egyptian Sakellaridis is grown successfully in several colonies.

Sisal is a coming crop of importance. It has only been tried out on the East Coast within a few years, but with remarkable success.

Tobacco is advancing as an African crop, particularly in the inland uplands.

Coffee growing is spreading in several colonies in the central portion of the continent.

Cocoa has been coming to the front rapidly during the past 20 years. The West Coast will presumably hold the leading place as a producer of cacao beans.

Kola nuts are also growing as an export.

The cereals, maize, wheat, barley, millet, durra, are increasing in quantity and have a great future at both ends of the continent.

The Soudan and Central Africa will continue to produce the bulk of the world's gum arabic.

Vegetable Oils Important

The palm oil tree of West and Central Africa becomes more important as the demand for its product increases in the tin plate industry, for soap manufacture, as a butter substitute and as a lubricant on many kinds of machinery. Regulations for conserving and replacing this valuable tree are being enforced so that Africa may continue to command the market in this commodity.

Climate and Soil

The principal drawback to the economic development of Africa is the climate. Much of the continent is practically uninhabitable for white men on account of tropical fevers and malaria. The inland plateaux are salubrious and are steadily attracting homesteaders. Nearly one-third of the continent is desert land and a large portion has light soil. Irrigation will work wonders in many sections. Where the richest soil is found the tse-tse fly and sleeping sickness exclude the white man. There are immense forests and jungles never penetrated by man or the rays of the sun. A fertile strip of land bordering the Mediterranean Sea, remarkable for its fine vineyards, is known as the Tell.

Rainfall varies from one-half inch on the Kalahari desert to 140 inches per year in the marshes of Calabar. Snow occasionally falls in Johannesburg and in Morocco. South Africa is mostly a tableland from 3,000 to 6,000 feet above sea-level—a land of sunshine much like California. Egypt has a dry and healthful climate but suffers from occasional sirococos blowing across the Sahara sand fields. Monsoons of the Indian Ocean are a disturbing factor on the East Coast.

Land Proprietorship

Many territorial changes have occurred since the opening of the World War. In 1912, eight European countries—England, France, Italy, Germany, Turkey, Portugal, Belgium and Spain—held dominion over Africa with but two independent states, Liberia, set up as a republic early in the past century under the patronage of United States, and Abyssinia, an unconquered upland, mountainous country. Egypt is now a sovereign state having passed from the control of Turkey to England in 1914, and in 1922 recognized by Great Britain as an independent nation. Morocco has become a de facto colony of France by virtue of purchase and conquest.

The former German colonies have been divided as war prizes in the following manner: German East Africa goes to the British under the name of Tanganyika Colony, except a small portion on the western edge bordering Belgian Congo, which falls to Belgium. German Southwest Africa is annexed to the Union of South Africa under British control. Togoland, on the west coast, is divided equally between France and Great Britain. The Cameroons were almost wholly assigned to France, the remainder to England.

Aside from the above territories acquired by war France has a larger territorial domain than Great Britain, though the land is not so well located, so productive or so thickly populated. The colonies of France are: Algeria, Tunis, Morocco, Senegal, Sahara, Senegambia, French Guinea, Ivory Coast, French Somaliland, Dahomey, French Congo, Madagascar and lesser islands.

Great Britain, besides her portion of the former German Colonies, holds possession of Gambia, Sierra Leone, Ashanti, Gold Coast, Nigeria, Union of South Africa, Rhodesia, Kenya, Soudan, British Somaliland, Zanzibar, Suez Canal and numerous small islands.

Belgium holds the extensive territory of the Congo, seized by King Leopold I in 1884 and opened up to international trade.

Italy obtained Tripoli as a result of the Turko-Italian war of 1912, and also possesses Eritrea on the Red Sea and Somaliland on the Indian Ocean.

Portugal, the pioneer explorer of Africa, retains Mozambique, Angola, Portuguese Guinea, the fertile islands of San Thomé and Principé and Cape Verde and Madeira Islands.

Spain clings to Rio de Oro, Muni, the Canary Islands, and a small part of Morocco.

Native Tribes

The tribal distribution of native races is somewhat as follows: The main race of Africans belongs to the Bantu tribe. These Bantu negroids are found mostly in the lower half of Africa, whither they were driven by the pressure of the invading Arabs and Moors from the north. They include such subordinate tribes as the Benga, Aduma, Umbete, Ashira, Bamone, on the Western Coast; in the Congo Basin the Luba-Lunba, the Ba-Kumu, the Ma-Supia, and the Wa-Buma tribes; on the Eastern shore, the Lacustrians, including Wa-Duruma, Ba-Toro, Wa-Sumbwa, Wa-Nyoka, and Wa-Nguru tribes; near the southern extremity of the continent are the Be-Chuna and Hamito-Bantu bushmen, Zulus, Matabeles, Numaqua, Ova-Herero, and Hottentots.

In the Nile valley are found the blackest negro tribes, including the Hausas, Dagos, Tumalis, Somalis, Korungas.

In Central Africa are found the pygmy tribes, said to be the earliest natives, whose stature averages about four feet. They are divided into the Dualas, Ashangos, Ba-Kundus.

In the northern regions are found the Berber tribes known as Lybians. In the Western Soudan are found the Fula tribes, the most advanced in civilization of the aborigines, and in the central Soudan are the Tibbus. The Hamites (descendants of Ham) are found in the eastern Soudan and throughout the Horn of Africa. The ferocious Somalis belong to this tribe. Abyssinia has a mixture of Hamites and Semites, who are closely related to the half breed Fellahin of Egypt.

In Madagascar the Hova and Malagasy tribes suggest that this island may have been peopled from the Malay peninsula as well as from the continent of Africa. These Hovas have embraced Christianity and have made a notable ascent in their civilization as compared with many of the continental tribes.

Labor Situation

The 150,000,000 natives of Africa are a potentiality rather than an immediately available reality in the problem of labor. Productive efficiency is at a low percentage. The negro is a child of nature and obtains his food supply with little exertion. Livingstone said that for any man merely to live and survive in Africa was a great achievement and very little should be expected in the way of moral, intellectual or physical energy.

Africa was principal field of supply for slave labor for the more highly civilized nations from the days of ancient Greece to the present century.

Slavery was supposed to have been completely abolished in 1906, though a system of forced labor continued in various regions.

The range in capacity for useful productiveness runs from the intelligent Fulani and Basuto tribes to the benighted pygmies and hottentots. As the black man evolves he becomes pastoral in habit, tending large herds of sheep and cattle—the next step is to take up cotton or rice cultivation—there is a long road to travel before he acquires proficiency as a skilled workman in a factory.

The native workman is always referred to as a "boy" regardless of age. The price paid to these "boys" is as low as ten rupees per month on the East Coast and fifteen francs on the Congo. Many thousands of Chinese and Hindoos were formerly indentured by the year to operate mines and plantations in South Africa. One of the chief occupations of the native is that of porter, averaging sixty pounds per man (or woman). Long caravans of porters bring small quantities of merchandise down to the seaboard.

The walking delegate has arrived in Africa—labor unions are organized among the miners—outbreaks of I. W. W. have been suppressed at Johannesburg. The importation of alcoholic liquors has been prohibited in the more backward colonies.

Under guidance of technical schools and missions the native will gradually acquire new ideas and learn to barter his time and energy to satisfy new desires. When the white "bosses" have made the black man both a producer and consumer of white man's goods, Africa will have a tremendous purchasing power.

FINANCIAL SYSTEMS

Africa is a cluster of colonies much like South America 100 years ago. Before the world war the money standards in these colonies were for the most part the same as in the eight different mother countries of Europe. Throughout the length of the East Coast the Indian rupee has been a current coin for centuries. In Northern Africa the Turkish piaster still circulates. The Egyptian pound is based upon 100 piasters and has a value somewhat above the English pound.

Most of the business of Northern Africa is conducted through houses in Marseilles or Paris and the franc is the standard of value. Great Britain has minted a special African West Coast currency of shillings and pence. Among the native tribes of the interior cowrie shells are yet used as a medium of exchange, and also salt bars.

The British Bank of South Africa has more than 300 small branches throughout the lower part of the continent. The National City Bank of New York is establishing agencies in several coastal cities of South Africa for the convenience of American shippers.

In most of the colonies there is a native hut tax which brings in a considerable revenue and gives the native the protection of law by becoming a part of the government. In South Africa this tax is one pound for the head of the family and one pound for each extra wife.

Customs Tariff

On the West Coast and the Congo the import tariff is 10 per cent. ad valorem. Certain specific duties run higher than the average 10 per cent., for instance, 12 per cent. on rice in Liberia, 20 per cent. on distilled spirits in Nigeria. In Morocco the tariff is 12½ per cent.; in Egypt 8 per cent. Algeria is considered a part of France and has the same rates as the mother country; 3 francs per pair on dressed leather shoes in Algeria. British East Africa is 10 per cent., Mozam-

bique has a schedule of specific rates and allows 50 per cent. discount to Portugal. The Union of South Africa is partly on the ad valorem, partly on the specific tariff basis. Most imports are taxed 20 per cent. of the value. Exports from America like petroleum and illuminating oils pay from 2 to 3 pence per gallon. There is a rebate of 3 per cent. to Great Britain and reciprocating colonies. To take advantage of the discount to English Colonies, Henry Ford ships his cars from the Canadian factories. Not many of the colonies have a differential tariff discriminating against the United States. Until War prohibition went into effect a high tariff on imported spirits and liquors was a great source of revenue.

Export duties imposed on many colonies during the War have now been repealed.

Transportation Facilities

Railways are being laid so rapidly that new maps cannot keep pace with the changes. When the World War broke out the Cape-to-Cairo railway was lacking 1500 miles between El Obeid in the Soudan and Bukama in the Congo. Stanley's prediction that this line would be completed by 1925 may possibly be fulfilled now that Great Britain has full control of Central Africa. Short railway lines are leading inland from the coast at many points, several of them built to transport troops to conquer the country. These lateral lines will ultimately tap the main transcontinental route and open up rich regions which will provision Europe with vegetable oils, cereals, sugar, coffee, cocoa, hides, meats, cotton and timber.

The French have a program of laying down 18,000 miles of track during the next 15 years at a cost of \$800,000,000. These lines will extend from Tangier to Alexandria along the Mediterranean shore—across the Sahara desert to Lake Chad and El Obeid—and, most important of all, from Algeria to Dakar at Cape Verde from which point travelers may continue a trip to South America by a sea voyage of only four days.

Instances are cited where the cost of transporting merchandise to the seaboard by gangs of porters has been reduced from \$200 per ton to \$10 per ton by rail.

The automobile, as a cargo carrier, is coming to the fore. The six-ox wagon of South Africa, the camel caravan of the north and the strings of human porters trekking across

the veldt carrying the freight upon their heads, are in many places giving way to the Ford truck. Metalled roads have been laid out in the French and British colonies. The sharp rise in grade from the seacoast to the tableland, makes a difficult problem for railroad engineers to overcome. The automobile can negotiate these grades more easily than the locomotive.

Marine Transportation

Keen competition for overseas trade since the War has resulted in much better shipping facilities for Africa than formerly. Several new steamship lines have more than replaced the defunct German companies. Japan has added lines to South and East Africa—the United States to North, West and South Africa. Modern refrigerator ships have been specially built for African trade by the Elder-Dempster Company. Four thousand ships annually pass through the Suez canal, the bulk of which are British, with only a handful of American register.

There are very few bays and arms of the sea indenting the continent to promote maritime trade. Usually there is a sand bar at the mouths of the rivers to prevent entry of any sizeable craft. In sections the larger rivers are navigable to shallow draft, stern-wheel steamers. Waterfalls, rapids and seasonal variations in volume of water preclude regular travel except by the much-used pirogue made of a hollowed-out tree.

Off the coastal ports vessels are usually obliged to anchor in roadsteads and embark freight by lighters. At Lagos a 30-foot channel has been dredged to the wharves—at Casa Blanca vessels of 35-foot draft may now come alongside the modern docks. At Durban and Port Elizabeth \$50,000,000 is being expended to install the most up-to-date appliances for loading bunker coal in the many vessels which call at these ports. At Dar-es-Salaam, Mombasa and Beira on the Indian Ocean port facilities have been greatly improved. Algeria and Alexandria harbors are literally "forests of masts" so many tramp vessels visit these shores.

Across such large inland lakes as Nyanza and Tanganyika there are steamers of 300 tons plying regularly.

The opportunities for developing hydro-electric power are unlimited. The falls of the Zambezi river are higher than Niagara and could supply tremendous power if South Africa should become an industrial center of factories.

The following steamship lines from America to Africa were operating in 1919: To South Africa, American and African, Funch-Edye, Houston, Prince and Union Clan lines; to West Africa, Elder-Dempster lines from New York. Trans-shipment routes from Liverpool, Southampton and Marseilles. To East Africa, all lines plying to South Africa occasionally extend service to East Africa. Trans-shipment to lines from Liverpool, Marseilles and Cape Town.

To Morocco, Algeria, Tunis,—best reached by trans-shipment from Gibraltar, Marseilles, Genoa, Barcelona.

To Egypt and Red Sea ports, Castriotis line, American and India line, Ellerman's Wilson line. Transshipment at Marseilles, Naples, Suez, Port Said and Aden.

Manufactures

The early civilization of the Nile valley had mastered the art of smelting ores and fashioning them into objects of great value, and also acquired high proficiency in hand-wrought articles as well as weaving. These handicrafts have been preserved by most of the black tribes.

Manufacturing by modern machinery has only recently been introduced into Africa. Algeria has mills for making flour and meal. Egypt manufactures cigarettes, Nigeria refines oil, Rhodesia has mills for rolling iron, South Africa is introducing plants for the manufacture of such articles as furniture, cement, boots and shoes, bottles, pottery and rough hardware.

But Africa looks to the outside world for most of its finished goods and several raw products. Before the War, England supplied gray sheetings, cotton piece goods and calicoes; France, automobiles and shoes; Germany, electrical goods, firearms and hardware; Austria, hats and fezzes; Holland, Schnapps and trade gin distilled from potatoes; Japan, rice and silks; Greece, tobacco; Scandinavia, casks and matches; Chile, nitrates, brought by vessels carry exchange cargo of coal from South Africa; United States, iron and steel products, windmills, well-boring machines, petroleum and furniture.

Four Trade Regions

By reason of geographical position, sovereign control, medium of exchange, and dominating commercial power, Africa divides into four trade regions. The Mediterranean

region, in which business is mostly carried on with French houses, although the Italians dominate Tripoli and a diversity of merchants do business in Egypt, includes Egypt, Tripoli, Tunis, Algeria, Morocco, Tangier and other Spanish possessions. Most of the commerce has been with trans-Mediterranean ports of Europe. But England, of course, takes the bulk of the Egyptian cotton crop and considerable barley, wheat and esparto grass from the French possessions. The United States has had very little steamship communication with this region since the days when the Barbary pirates preyed upon its merchant marine until suppressed by Bainbridge and Decatur. Greeks control the sponge and pearl fisheries.

South Africa includes the British possessions of Rhodesia and the Union of South Africa, Portuguese East Africa, through which the bulk of foreign commerce is made up of English goods in transit; German Southwest Africa, which was subjugated by the British during the World War, and Angola, a minor province, through which an outlet by rail will soon be completed for the product of the English-owned mines of Katanga. The bulk of the shipping to these ports was carried in British bottoms, although before the War the German Woermann line and the Ost Afrika line were picking up a very large trade. The United States has regular steamer communication with this section, to which it ships a large quantity of mining and agricultural machinery, and from which it brings a great deal of wool. South Africa, which claimed 65 per cent. of the total trade in 1900, has now fallen to 45 per cent.

The West Coast embraces French West Africa, including Dahomey, Guinea, Gaboon and French Congo, the former German colonies Togo and Kamaroon; the English Nigeria Gold Coast, Sierra Leone, Gambia, Liberia, the Negro Republic under a quasi-protectorate of the United States, and Belgian Congo. The United States has had no direct line of steamers until after the War. German vessels had carried most of the commerce of this region, which consisted mainly of palm products. Several English lines of steamers call at the English ports, and take on bunker coal at Port Harcourt.

The Indian Ocean region includes the Red Sea ports of Eritrea, the Somalilands, Abyssinia, British and German East

Africa, and Madagascar. These colonies are controlled by Italian, French, German, English officials. Trading is chiefly in the hands of Arabs and Jews, and largely carried on with India, Australia and Japan. The Japanese have two lines of steamers touching at these ports, which have taken over a large part of the trade carried by the German Ost Afrika line. French, Portuguese and British steamers sail through the canal, but the German line had the best passenger traffic and carried most of the hunters to this region. The United States has occasional steamship connections with Madagascar and the East Coast but most of the commerce requires transhipment at the Cape or at Alexandria. The output of the Congo, Rhodesian and Transvaal mines is at present carried through the East Coast ports.

Trade With United States

In 1910, South Africa imported from Germany 16.8 per cent., from the United States 7.8 per cent., from England 59 per cent. The principal exportations from Africa to the United States are wool from South Africa (some hundred thousand bales); cotton from Egypt of a similar amount; palm oils and a rapidly increasing share of the cocoa product from the West Coast; considerable asbestos from South Africa; wattle bark and mangrove for tanning leather from the East Coast; cloves and vanilla from Zanzibar and Madagascar; graphite from Madagascar; chrome iron from Rhodesia; phosphates from Tunis; sisal and rafia from the tropics; ivory and rubber from the equatorial belt; and hides from all quarters, particularly Cape Town, Nigeria, Morocco, Soudan, Abyssinia, British East Africa and Madagascar.

Of the total United States imports in 1913 1.46 per cent. came from Africa and in 1918 2.58 per cent. Of the total U. S. exports in 1913, 1.18 per cent. went to Africa. During the War of course Europe absorbed the vast bulk of U. S. exports and the African percentage fell.

Since the beginning of the World War the following exports from United States to Africa have greatly increased: Candles, automobiles, anthracite coal, motorcycles, biscuit, rice, blacking, brass manufacture, sodas and salts, baking powder, horses, dyes, clocks and watches, confectionery, dental goods, soap, explosives, canned fish, optical instruments, bar iron and iron wares, builders' hardware, engines

of all kinds, cutlery, shoe and textile machinery, nails, iron pipe, wire fencing, lamps, condensed milk, victrolas, oil cloths, steel and iron plates, newspaper and all other varieties of paper, bags, boxes, motion picture films, roofing felt, cigarettes, shooks, glass bottles, jewelry, copper rods and wire, electrical appliances, petroleum, steel rails and agricultural implements.

Africa and the Great War

Africa did not suffer materially from the World War. Her commercial position in the world was strengthened. The wholesale destruction of ships by submarines threw the colonists upon their own resources largely. Many new manufacturing plants sprang up which will continue. Production of staple commodities was stimulated and new fields opened up. The United States and Japan have divided most of the trade which formerly went to Germany.

Outlook for Next Few Years

Africa is the largest area in the world awaiting development. Although Egypt had a flourishing civilization centuries before Europe and 2000 years before America was dreamed of, modern Africa is only about 50 years old, dating from the opening of the Suez Canal in 1869 and Livingstone's trip across the continent. The European scramble for colonial possessions reached the climax in 1884.

Gold and slaves were the wealth sought by adventurers during the 18th and 19th centuries. Utilization of the land for commercial purposes has really only commenced in the last few decades.

Since the World War ended attention has been directed to the Dark Continent more intensively. Victor Hugo, in the middle of the last century, prophesied that Africa would be the cynosure of the world in the 20th century. The new spirit of internationalism, which holds that each country shares in the prosperity or distress of all other countries, is endeavoring to erase geographical boundaries and national barriers so as to equalize opportunities for advancement of all nations and bring about a more even distribution of those things that make for common human happiness. The mental interval between the average black man and average white man is so wide that this continent offers the greatest field for development. White man's capital will work wonders in black man's Africa.

ANIMAL PRODUCTS

Africa has been most widely advertised through its animals. School boys the world over have pictured the Dark Continent as a vast zoological garden. Although the wild animals are gradually dwindling, Africa seems particularly adapted to support a vast quantity of domesticated stock in a practically virgin field. Animal husbandry for the future apparently centers in cattle and sheep-raising on the vast stretches of hinterland obtainable at low prices. Cattle in South Africa, like camels in Northern Africa, have been bred largely for draught purposes and may be doomed to reduction in numbers by recent mechanical inventions for transportation, though horses and mules have increased in spite of the motor car.

The hilly topography and dry, warm climate of the continental extremities are favorable to wool-growing which is advancing in Morocco, Algeria and Cape Colony. Cattle do not require hill country and thrive on the immense, broad, inland plateaux. Canned and frozen meats are constantly increasing for export. Hides and skins come from every corner of the continent. Dongola and Morocco have contributed to the world's styles of leather. Hogs thrive wherever corn will grow, i. e., throughout Africa, although the climate and religious prejudice restrict their numbers. Introduction of alfalfa will increase domestic livestock.

Africa leads the world in production of ostrich feathers (90 per cent.), ivory (80 per cent.), big game (60 per cent.), mohair (50 per cent.), and takes high rank in the production of wool, hides and skins, camel's hair, coral, sponges, tunny, anchovies, civet, guano, egret feathers and bees-wax.

Along the Mediterranean littoral there is an immense production of eggs for European consumption. Butter and cheese are increasing exports from South Africa—ghee from Somaliland and Abyssinia.

Sea products come from the Northwestern and Southeastern coast especially. Tunny abound off Tunis, anchovies off Algeria, coral off Morocco, sponges off Tripoli, pearls in the Red Sea, turtles at Madagascar. Seals and whales are not so plentiful as formerly. Much guano is gathered from the dry islands near the coast.

For increased production of fish, fowl and flesh, the latter holds the greatest promise for broad commercial development.

WOOL

Sheep-raising is most profitable in dry, elevated regions where there is good pasturage. The best wool is produced in countries where fat is not created for bodily warmth. Damp, cold regions produce the best mutton. Thus the northern and southern extremities of Africa are well-suited to wool production. The heavy rainfall of the equatorial belt is not favorable.

The total number of sheep in the world

Sheep Census. (1918) has been estimated at 600,000,000.

Australia and Argentina are the largest sheep raising countries. Sheep in Africa for 1918 are estimated at 74,000,000, distributed as follows:

Algeria	8,500,000
Morocco	5,000,000
Rio del Oro	100,000
Senegal and French West Africa.....	500,000
Gambia	100,000
Dahomey	100,000
Togoland and Kamaroos.....	250,000
French Guinea	150,000
Angola	100,000
German Southwest Africa	2,000,000
Union of South Africa.....	35,000,000
Rhodesia	400,000
Mozambique	200,000
Madagascar	500,000
German East Africa.....	5,000,000
British East Africa.....	6,000,000
Abyssinia	3,000,000
Somaliland (British, Italian, French).....	1,000,000
Egypt and Soudan.....	1,300,000
Tripoli	1,500,000
Tunis	1,100,000
Islands	50,000

The Tanner's Council estimates sheep in Africa at 77,000,000.

Quantity of Wool. According to statistics of the National Woolgrowers' Association of America, the total wool production of the world for 1918 was 2,808,796,243 pounds, of which Africa produced 207,680,470 pounds. The United States produced 299,921,000 pounds. Forty-five per cent. of the wool production is within the British Empire, particularly Australia, South Africa and New Zealand, which have almost a monopoly of fine merino wool. Production in Africa was approximately as follows:

Union of South Africa.....	160,000,000	pounds
Algeria	33,000,000	"
Rhodesia	50,000	"
Egypt	8,000,000	"
British East Africa	500,000	"
Tunis	4,000,000	"
Morocco	5,000,000	"
Madagascar	3,000,000	"
German Southwest Africa.....	2,000,000	"

Total world's product (1914) was 2,900,000,000 pounds, of which Africa furnished 150,000,000 pounds. The Philadelphia Commercial Museum gives 225,000,000 pounds for 1913.

Breeds of Sheep and Quality. The most characteristic African breed is the fat-tailed sheep. The lump of fat in the tail like that on the back of the camel or the withers of the zebu is a provision of nature

for resisting prolonged drought affecting vegetation. The Merino sheep, which is the main stock of the South African flocks, originated in Northern Africa, and was improved in Spain, from which it spread over the world.

Karakul sheep, which produce the lambskins valued as astrakan, are numerous in many sections. These sheep came originally from Bokhara, Persia. Living in arid countries for many generations and subsisting on scanty fare, they have acquired great hardihood; consequently they are profitable in large barren regions of the Union of South Africa. Infusion of Karakul blood on the Africander stock makes a profitable sheep both for wool and mutton. Merino is not so good for mutton as crossbreeds.

In Abyssinia, a race of very small black-headed sheep, the flesh of which is unusually good, is raised for wool. The clip is manufactured locally into coarse cloaks worn in the hill regions. The price of this sheep varies from 38 cents to \$1.93.

Wild Barbary sheep (*Ovis tragelaphus*) are found in the northern outskirts of the Sahara desert, but they are of value chiefly to hunters and as staple exhibits in zoological gardens.

The ovine herds of the northern French colonies are of two classes: One, permanently stabilized in the oasis; the other ranging over the great open steppes, seeking pasture. The size of the nomad herds varies yearly according to amount of rain and weather conditions. The permanent herds consist of five or ten sheep at each oasis where they have abundant food and produce excellent mutton. The oases of Gabes support 50,000 sheep of the large fat-tailed variety known as

"Barbarin". The wool, spun by the women, is used for carpet-making, and especially, for burnooses.

In Egypt the prevailing color of the sheep is brown. They furnish a coarse wool for carpet and rug making.

The common sheep of Nigeria are wire-haired, long legged, short-horned and carry a mane. Fat-tails are the common sheep of Madagascar.

South African Clip. The Union of South Africa is the leading country of Africa exporting wool, and, within the British Empire, is second only to Australia.

The total wool clip for 1918 was 500,000 bales against 450,000 bales for 1917. There are in South Africa 35,000,000 sheep, of which about 5,000,000 are bred for mutton rather than for wool. The number in 1913 was 30,000,000, mostly of Merino and cross-bred stock. South African stock-raisers occasionally shear their sheep twice a year, a detriment to the trade. The wool is not of the very highest grade, as the sheep do not feed on grass, but on a shrub called "karoo", growing in the red sand, and bearing a burr which catches in the fleece. Tags are common, which depreciates the wool, as do also the dust storms and blazing sun.

There has been a growing shortage of wool during the war period, due to drought in Australia, to the use of pastures for other agricultural purposes and to the increase of the mutton supply by cross-breeding. Wool is being scoured in South Africa and machinery has recently been shipped for textile industries, which should prosper, as the climate is as favorable as that of Philadelphia.

Quantity. Wool production in South Africa for the five-year pre-war average, 1909-13, amounted to 145,000,000 lbs. The production of Merino wool in South Africa averaged about 130,000,000 lbs., or 90 per cent.

The average exports to Great Britain preceding 1913 were 115,000,000 lbs. The amount of clothing wool shipped to the United States was 66,500,000 lbs. in 1916.

The Statistical Abstract gives the following wool production for 1913 and 1915, showing the changes during the first years of the war, when Egypt doubled its output:

	1913	1915
Union of South Africa.....	176,971,865 lbs.	170,009,886 lbs.
Southern Rhodesia	34,784 "	36,123 "
East Africa Protectorate.....	233,184 "	321,328 "
Egypt	4,981,183 "	8,148,475 "

Wool from Northern Africa, which is not a large clip, goes to Marseilles and Genoa principally. Many live sheep are exported from Northern Africa.

Export Figures:

1913	Morocco exported wool to the value of	1,300,000
1915	Egypt exported 72,734 cwt. wool, valued at \$1,227,000	
	Algeria exported wool to the value of.....	3,198,400
	Algeria exported sheep to the value of.....	8,288,000
	Morocco exported wool to the value of.....	615,166
	Union So. Africa exported wool to value of....	26,861,775
1916	Egypt exported wool worth.....	1,350,000
	Morocco exported woollen goods, value of....	44,000
1916	Union So. Africa exported wool to value of....	33,000,000
1917	Union So. Africa exported 117,657,142 pounds.	

Markets. Before the war Germany and Austria consumed 30 per cent. of the best African wool. With the elimination of Germany from the wool market, Japan increased her purchases from South Africa. During 1917 the British Government took two-fifths of the supply and the keen rivalry between Japan and the United States boosted the price above that paid by the English Government, much to the discontent of the Cape sheep-raisers. The purchases by the Japanese were mostly of combed wool, while that taken by the United States was scoured wool.

The bulk of the African wool crop goes to Yorkshire, England. Plants of the American Woolen Company in New England and the large factories in Philadelphia receive a considerable amount of South African wool which often comes in square-rigged sailing ships.

Prices. At the English Government auctions, which have been resumed since the war, the range of values in April, 1919, for South Africa, was as follows:

Grease,	Western District, 30d. to 36½d.
	Port Elizabeth, 24½d. to 36d.
	Natal, 19d. to 38½d.
Scoured,	Port Elizabeth, 41½d. to 67d.
	Natal, 48d. to 56d.
	East London, 48½d. to 58½d.

The average price of wool for 1917 was 33 cents per pound. In 1913 the average price was 15 cents per pound. The British Government offered to take the clip of 1917 at a price of 55 per cent. higher than the average before the war (about 27 cents per greased pound); 200,000 bales (about two-fifth of the clip) were sold under this arrangement. Many

of the farmers broke their contracts when they found that the United States or Japan would pay a higher price (reaching 36 cents per lb.).

The cost of feeding sheep in South Africa has been given as \$4 per year per head.

Outlook for Wool. Wool-growing has undergone many vicissitudes in Africa during the past half century. Flocks have been decimated by occasional severe drought, and ravages of scab, tick, redwater, and other diseases have periodically discouraged the sheep-raiser. Dipping in tanks of arsenic water or lime and sulphur to destroy disease-breeding flies and insects has become more general in South Africa and is a great protection. There has been an increase in the number of veterinaries to combat the diseases attacking all animals. By experimentation flocks have been improved and breeding stock has been transported free of charge by the Union Castle Line from England. Although there was a slight falling off in production due to the exigencies of the war, there has been a steady increase in the wool output of Africa, and the probability is that the industry will continue to expand throughout the broad pasture lands. Japan will presumably make regular and increasing purchases of African wool for transportation by her new steamship line. The returning soldiers are likely to take up sheep-raising on the tracts of land granted them in Rhodesia. There has been a marked increase in the flocks of Egypt and in British and former German East Africa, where pasturage is abundant. The new régime in Morocco is likely to encourage wool-growing in that well-watered country where Van Loo, the Belgian economist, estimates that 40,000,000 sheep could be pastured. Algeria has not so many sheep as formerly.

MOHAIR

Goats are found in practically every country of the world. Their present number is estimated as above 200,000,000. India is credited with 24 per cent.; Africa with 15 per cent.; Turkey in Europe with 10 per cent.; Turkey in Asia with 8 per cent. Their distribution is much the densest in the Balkan States and Greece. The common native goat is kept for its milk, meat and hide rather than for its hair, and no family in Africa, whether Arab or black native, would be considered of any account if it did not have a dooryard group of goats. The

goats around Guinea are dwarf, plump, short-legged, close-haired with short horns. Raising Angora goats for hair is confined to the white settlers. The six or eight millions of Angora goats of South Africa have been the great source of supply of mohair for the European market, the chief rival being the Turkish domains.

Goat A rough estimate of the caprine population of Africa for 1918 might give in the neighborhood of 40,000,-
Census. 000 head, of which about a quarter are Angora goats.

Algeria	4,000,000
Morocco	2,000,000
French West Africa	200,000
Gambia	300,000
West Coast	200,000
Upper Nigeria	200,000
Angola	50,000
German Southwest Africa	500,000
Union of South Africa	11,000,000
Mozambique	100,000
Madagascar	200,000
Rhodesia	600,000
British East Africa	4,000,000
German East Africa	1,000,000
Abyssinia	7,000,000
Somaliland	1,500,000
Egypt and Sudan	1,000,000
Tripoli	500,000
Tunis	600,000
Islands	1,000,000

The Tanner's Council estimates 49,000,000 goats.

In the Abyssinian districts and the Eastern Horn of Africa goats are more numerous than sheep or cattle. The native goat yields a larger quantity of milk than the ewes and also provides a better tasting meat. These goats are of the short-haired variety, and usually white, although a black and tan or pied variety is not uncommon. They are herded together with sheep. Aden is the regional market.

Mohair is obtained from the **Angora goat** (*Capra angorensis*). This valuable hair is used for railway seats and other upholstery, coat linings, women's dress goods, auto tops, carriage furnishings, rugs, braids, imitation furs, false hair, plush, velvet, men's summer suits. Hair of the common goat is used in coarse blankets and carpets.

Where Found. The Angora goat, which originated in Asia Minor, is bred principally in Asiatic Turkey; in South Africa, where it was introduced a hundred years ago; in the semi-arid southwestern States of America, where it was recently introduced to clear up underbrush on the timberlands; and in Argentina. While the Asia Minor Angora goat produces the finest quality of hair, the South African goats produce the largest quantity of any section in the world. Although the Turkish supply was wholly cut off by the war, nevertheless exports from South Africa decreased heavily, partly on account of women curtailing the use of mohair as a war luxury.

Markets. Port Elizabeth is the chief shipping port for the South African mohair clip, which is raised on the highlands back from the coast. During the year 1918 about a million pounds were sent to the United States. Exports from South Africa to Bradford, England, were 11,273,995 pounds in 1916, and 3,577,848 pounds in 1917. Exports from South Africa for recent years are as follows:

1909	19,600,000	pounds.....	£862,000
1911	21,100,000	"	918,000
1913	17,400,000	"	876,000
1917	3,691,000	"	280,661
1918	3,630,000	"	

Prices. The price of Basuto mohair was 34 cents per pound in 1918. The South African goats yield a fleece of about 3 pounds each. The average receipt per goat in 1913, was \$1.02. The war caused a slump in the market for mohair.

Camel Hair. The camel produces a fine wool, especially adapted for making hosiery, underwear, shawls, carpets and rugs, a valued cloth, fine soft brushes. At certain seasons of the year the camel's hair loosens and is plucked out by hand. The camel of Africa, by reason of his drought-resisting qualities flourishes in the arid regions of the Sahara and the Somali deserts, where he feeds on the scant vegetation at small expense to the owner. The northeastern third of Africa comprises the principal habitat of the camel. During the dry season on the West Coast many are driven down from the Sahara by the Moors.

Possibly the total number of camels in Africa amounts to 3,500,000, but no authentic figures are available because they are owned mostly by the wandering Arabs and are not

listed on tax books. Enumeration is not reliable as the caravans move from one place to another. Estimates, from several sources more or less conjectural, give the number of camels in Africa, as follows:

Algeria	204,715
Egypt	100,000
Eritrea	46,853
German Southwest Africa.....	800
Senegal	12,487
Soudan	123,705
Tunis	121,000
Tripoli	300,000
Morocco	200,000
Abyssinia	500,000
Somaliland	1,000,000
German East Africa	10,000
U. of South Africa.....	3,000

Outlook. At the end of the war there was a large surplus stock of mohair in storage; the number of Angora goats had greatly diminished. The market is likely to recuperate, particularly on account of the great demand throughout the world for animal fibres suitable for clothing and owing to resumption of former fashions in dress and furniture. South Africa is especially adapted by climate, topography and vegetation to the raising of these goats. Flocks have been introduced into British and former German East Africa where they are steadily increasing.

HIDES AND SKINS

Hides and skins constitute a large part of the commerce of Africa. They are obtained both in the coastal and interior countries. Every caravan includes one or more camel-loads of skins. Countries in which hides and skins are a large percentage of exports are: Algeria, Morocco, Senegal, Nigeria, Union of South Africa, Madagascar, Mozambique, British East Africa, Somaliland, Abyssinia and Tripoli. Rhodesia is growing in importance in this industry. Several of the colonies are not well suited as habitation for domestic animals, e. g., Angola and the Congo, where the severe climate of the summer, when heat and humidity are intense and water often scarce, together with the tse-tse fly and the epidemic known as rinderpest, create conditions fatal to stock-raising. In Tripoli lack of vegetation owing to the scanty surface supply of water prevents cattle-raising to any extent.

World Production. The world's annual production of hides and skins is above 2,000,000,000 pounds, of which Africa produced in the year 1917, about 170,000,000 pounds. The British possessions in Africa (especially South Africa) produced 50 per cent. of this total; the French possessions (chiefly Madagascar, Morocco and Algeria) produced 33 per cent., and Abyssinia about 10 per cent.

In estimating the number of hides and skins from Africa it is important first to enumerate the number of domestic animals. The sheep census has been given as approximately 74,000,000, and goats roughly as 40,000,000. The total number of cattle in Africa is in the neighborhood of 45,000,000. The estimate for the world total of cattle is 425,000,000, India having first place in distribution, United States second, Russia third. Africa ranks fourth, having about 10 per cent. of total.

ESTIMATED NUMBER OF CATTLE IN AFRICA, 1920

Algeria	1,100,000
Morocco	3,000,000
Rio de Oro	100,000
Senegal and Sahara	2,000,000
Gambia	100,000
Liberia	200,000
Sierre Leone	100,000
Gold Coast	100,000
Dahomey	100,000
French Guinea	500,000
Nigeria	3,500,000
Togoland	75,000
Congo	100,000
Kameroons	50,000
Angola	100,000
German Southwest Africa.....	300,000
Union of South Africa	8,500,000
Rhodesia	1,500,000
Madagascar	6,750,000
Mozambique	500,000
German East Africa	2,000,000
British East Africa	2,500,000
Somaliland	1,500,000
Abyssinia	7,000,000
Tunis	200,000
Egypt and Soudan.....	1,000,000
Tripoli	200,000
Islands	100,000

These estimates are conservative.

Tanner's Council (1920) estimates 73,000,000 cattle.

The motor car seems to have doomed the horse the world over and yet there are probably more of the equine family in Africa today than ever before. Many mules have recently been shipped to Africa from America.

From fragmentary figures a conjectural estimate may be made of 1,500,000 horses in Africa, and 3,000,000 mules and asses. The zebra has been domesticated and has been crossed with the mare, producing the zulebra. Horses do not thrive in tropical Africa on account of the tse-tse fly.

CENSUS OF HORSES IN AFRICA

Union of South Africa.....	(1913).....	719,500
French Guinea	(1914).....	3,000
Tunis	(1916).....	31,000
Basutoland	(1911).....	86,600
Swaziland	(1917).....	600
Algeria	(1917).....	250,000
Egypt	(1917).....	50,000

MULES AND ASSES IN AFRICA

Union of South Africa	450,000	mules and asses
Tunis.....	225,000	mules and asses
Algeria.....	233,000	asses
Algeria.....	192,000	mules
Nigeria.....	25,000	mules and asses
Senegal.....	50,000	" " "
Egypt.....	700,000	" " "

Nyassaland had in 1917 only 266 horses, mules and asses.

In Egypt are many mules bred from Abyssinian mares and sired by donkeys. These mules average 13 hands high and will carry 200 pounds on rough trail. They are worth on an average, \$28.

Cattle-Raising. Africa, in proportion to its immense extent is very sparsely populated; the chief cattle-raising district lies in the southeastern section, as in the case of New Zealand, Australia, India and South America. In Southeast Africa there are about 25 cattle to every ten inhabitants, while in Uruguay there are 75 to every ten inhabitants; in Russia 30.

The fencing item of expense is an important reason for the want of interest in cattle-raising on the African veldt. Additional reasons why the cattle regions have not expanded to the saturation point in the African grazing uplands are found in the ravages of the tse-tse fly and other plagues; in the fact

that the Mohammedan population eats little beef; the liability to attack by marauding wild beasts. But when man has mastered the African continent, overcome insect pests and crossed it with railroads as he has the western prairies of the United States there is no reason why the savannahs, veldts, plateaux and steppes of Africa should not provide grazing land for a quarter of the world's cattle; notwithstanding the claim of Steffanson, the Arctic explorer, that the grasses and mosses of boreal regions are destined as the future grazing fields of the beef creatures of the world; and that the tendency of civilization is toward the poles.

Breeds of Cattle. The breeds of cattle producing hides in Africa are of four principal kinds. Those of Algeria and Tunis are largely imported Swiss stock. In Egypt and Eastern Africa there is found a cross between the zebu from India and the native buffalo, which has long been domesticated. Madagascar cattle are of the humpbacked Indian species. Buffalo on the West Coast are small and red. Those of Nigeria came originally from India and roamed for centuries the rich grass lands of the inland plateaux, tended by the Haussa and Fulani tribes. Hides from this region formerly went by caravans across the desert to Mediterranean ports but are now mostly carried by rail to the Gulf of Guinea. Liberia has a breed of cattle no larger than Shetland ponies—so small their pelts are classed as skins like sheep and goats. Skins of small or young animals are known in trade as "kips". In South Africa Scotch Shorthorns, Holsteins and Herefords, standard breeds introduced from northern Europe, are abundant. During the Boer war cattle were nearly wiped out but had recuperated to 6,000,000 head by 1914. There is a black native buffalo found in South Africa.

On market days centres like Pretoria and Johannesburg have the appearance of the Chicago stockyards from the multitude of horns, for these animals are valuable not only to provide meat for local consumption and hides for export but particularly as motive power for transportation—unusually primitive in this day of the almost universal automobile.

Quantity. Tons of hides are brought by caravan from the interior to coast towns in every section, often to be prepared for leather but more commonly to be exported in the rude condition. African hides come under the head of "country hides" and are less valuable than "packer hides" from large abattoirs. The leather trade in all its

branches becomes more important every year and Africa's part in supplying the world demand is steadily increasing. Many shoes are manufactured by modern machinery in South Africa.

Madagascar exported (1917) 6,000 tons of hides and skins, and endeavors to maintain an annual exportation of 800,000 skins.

The total number of hides and skins, including those of the camel, horse and wild animals, exported each year from Africa, is probably as high as 15,000,000. The Tanners' Council estimates the average annual shipment from Africa of cattle hides at 60,000,000 lbs.; of sheepskins at 44,000,000 lbs.; goatskins, 24,000,000 lbs. The value is approximately \$50,000,000.

Skins of Wild Animals. An important skin, tanned and used for many purposes, is that of the porpoise or white whale, exported from the east, west and southern coasts of Africa. Skins of the sperm

and whalebone whales are also tanned and exported for manufacturing purposes, especially from Madagascar. The hide of the rhinoceros is used for making stout belting and whip lashes, particularly the sjambok employed by the German officials to stimulate activity of indolent natives. The crocodile skin is used for making travelling bags and fancy articles and elephant's hide for trunk-making and heavy casings. The camel's skin, very thin and strong, is used by the Bedouins for tent-making, and is made into watch and spectacle cases. Monkey skins go into jewel cases, linings of bags, and other purposes which call for a soft, pliable leather. Monkey furs are also made into muffs and coat trimmings when fashion dictates.

Ostrich skins have been tanned since the war began for hand bags, furniture linings and wallets.

Relative Quality. Hides and skins from dryer parts of Africa are considered best because of their toughness and strength due to the lack of fresh grass. Eating of much green grass seems to lessen this special and much-desired quality of leather. For the same reason hides and skins taken after dry months are preferred to those obtained soon after rains. But hides and skins of the coast lands are generally superior to those of the interior, perhaps due to the fact that they are better treated and not so much handled. The best

hides and the best meat can be produced on the same cattle, whereas the best wool and best mutton are produced on two different kinds of sheep. But the poorer the wool the better the leather is the rule. Hairy fat-tail sheep produce the best leather. The best sheep skins, rarely weighing over three pounds, come from Somaliland, the finest quality from the "blackheads". South African sheepskins average 4½ lbs. Large Abyssinia and other East African cattle hides weigh between 25 and 30 pounds, but the average African hide weighs much less owing to the large number of young animals killed, often by disease or as a result of the locust plague, their skins being prepared for market whether they are killed for that purpose or die of natural causes.

Hides and skins are bought separately by the traders. Being paid for according to weight, rocks and other heavy objects are occasionally slipped into the folds to increase the weight. Many flaws are often caused by branding marks, disease and scars from injuries. Great want of skill in branding and flaying cause much waste and loss, especially in the Union of South Africa, where the value of hide bulks less largely than it should in the list of exports.

Uses and By-Products. The roughest raw hides are manufactured into ropes, whips, lariats, belts, faces for mallets, rough boots. Calf skin, when tanned, is used

chiefly for uppers of boots and shoes, but has many other uses also where a strong leather is needed. Tanned hog and pig skins are used for saddles, harness, straps, saddle-bags. Horse hide is especially used for shoes, saddles, razor-straps and American base-balls, while the long hair of the manes and tails of this animal is a valuable article of commerce used in the making of hair cloth, brushes, bows for musical instruments; and curled, is used for stuffing mattresses and cushions. Cattle hair is used for mixing plaster and making roofing felt, while hair from the tails goes into upholstery.

Sheep skins, with the wool left on, are often made into rugs, and in mountain regions into jackets, for which purpose African skins are exported. Goat skins are also used for rugs, both manufactured in Northern Africa and exported as skins. Goat skins that have been peeled down the body, in rounded form, are used by Moors and Arabs for water bottles. Egyptian sheep skins make fine soft leather much used by the natives for their comfortable shoes without heels.

The material known as Morocco leather is made chiefly from goat skins, tanned and dyed in a particular manner, and often ribbed or rough-grained on the surface. The manufacture of this leather began in Morocco and the Soudan, but it is now carried on in America and other countries. The colors used are chiefly red, brown and yellow, obtained from sumac, cochineal, the cuttle-fish and now coal tar. Black, green and blue are sometimes used. As goat skin takes dye better than any other and makes a rich color, goats are raised in large herds in Morocco for this leather.

Parchment, one of the oldest and most valuable of skin productions of Africa, is prepared with a great deal of care. It comes from various animals, that used for writing is mostly from the sheep and she-goat. The finest quality is made from very young calves, kids and lambs; and the thicker and coarser sort, used for drums and tambourines, comes from old goats and sheep. The ubiquitous drum of Africa requires a large number of skins.

Exports from African Colonies. In 1913 Morocco exported sheep and goat skins to the value of \$1,230,981, and hides to the value of \$732,142, which may be estimated as 6,000,000 pounds of goat and sheep skins, and 1,400,000 pounds of cow hides.

Algeria exported in 1913, 1,845,890 pounds of raw hides and skins, valued at \$1,304,400; and dressed skins, 2,420 pounds, valued at \$31,800. Besides these Algeria exported this same year manufactured articles of leather to the amount of 84,920 pounds, valued at \$359,200.

Egypt exported in 1913, 10,754,000 pounds of hides and skins, valued at £235,515, which fell to 7,554,000 pounds in 1916, but worth £417,820.

Two hundred and fifty thousand buffalo calf skins come from Egypt and Soudan annually.

Abyssinia and the Soudan are fine stock-raising regions on account of their grassy hillsides and fertile valleys. Large quantities of hides and skins from Abyssinia are exported via Messena and smaller lots go through Somaliland. Nearly half the skins shipped through the Aden market come from Abyssinia, which exported 12,694,000 lbs. in 1916, or 1,200,000 pelts. Another estimate of the goat and sheep skins exported ran as high as 5,000,000 for that year.

British East Africa exports about 4,000,000 pounds of hides and skins annually, valued at \$1,340,000 in 1915.

German East Africa exported 6,000,000 pounds of hides and skins annually before the war.

The exports of hides and skins from Nigeria in 1917, were valued at \$4,000,000, which would represent approximately 10,000,000 pounds, or a million kips.

In 1914 Senegal exported 594,869 pounds of beef hides and 229,042 pounds of sheep and goat skins.

In 1915 Tunis exported 12,700 beeves, valued at \$638,-300. In Tunis the importation from the desert of raw hides of large sizes quadrupled from 1912 to 1914, and lamb and kid skins increased ten-fold in quantity. Exportation of small skins has increased, but exportation of large hides has decreased. The small skins before the war went to Germany and Austria as well as France. The large hides went to Italy, France and Algeria.

Somaliland exported hides and skins worth \$550,000 (1915).

Live animals and their skins are among the important exports of the Cape Verde Islands that afford good pasturage.

Sections of the Canary Islands raise many domestic animals, especially goats, which thrive both in the hills and valleys. These animals furnish most of the milk, which is their chief value, but they also furnish many skins for leather. In 1915 these islands produced kid skins to the value of \$40,000, and in 1916, to the value of \$65,000. Oxen are used for plowing and hauling and supply much leather.

Union of South Africa. The exports of hides and skins come third in value among the non-mineral exports of the Union of South Africa. The following figures show the rapid increase for five years:

	1909	1913
Ox and cow hides.....	\$1,500,000	\$3,925,000
Goat skins	1,200,000	1,500,000
Sheep skins	2,600,000	4,400,000

Average exports from South Africa before the war were 18,000,000 lbs. of cattle hides: 32,000,000 lbs. sheep skins; 7,000,000 lbs. goat skins.

In 1916 the Union of South Africa exported 58,387,000 lbs. of hides and skins worth \$11,500,000; in 1917 the Union of South Africa exported hides and skins to the value of \$12,779,497, of which \$8,819,164 worth went to the United Kingdom and \$3,908,213 worth to the United States.

In Madagascar since 1901, the preparation of raw hides has been carried on with that of canning and freezing meats. The skins are prepared with common salt or arsenic salt. As the quality of the hides improves with more careful and scientific preparation, exports of this product will increase.

An estimate of the total export of hides and skins from the whole of Africa during the disorganized commercial conditions of the war may be hazarded from the following incomplete statistics:

	Export Value of
1915 Algeria, Hides and Skins.....	\$1,660,186
" Prepared Skins	129,888
" Senegal, Hides and Skins.....	373,749
" Gambia, Hides	57,959
" French Guinea, Hides	811,943
" Nigeria, Raw Hides and Skins	1,114,567
" Tanned Hides and Skins.....	357,014
" Katanga, Hides	10,000
" Union of South Africa, Sheep Skins	4,137,950
" Madagascar, Raw Hides	2,672,222
" S. Rhodesia, Hides and Skins	191,800
" N. Rhodesia, " " "	38,776
" Durban, " " "	1,839,527
" Mombasa, " " "	984,477
" Fren. Somali, " " "	461,517
" Egypt, " " "	1,511,007
" Abyssinia, " " "	1,500,000
1916 Algeria, Hides and Skins	1,767,494
" Prepared Skins	121,204
" Tunis, Hides and Skins	3,780,662
" Egypt, Hides and Skins	2,084,922
" Nigeria, Raw Hides	1,187,888
" Tanned Hides	1,434,482
" Union South Africa, Hides and Skins.....	12,600,000
" Abyssinia, Hides and Skins	3,500,000
1917 Union of South Africa, Hides and Skins.....	12,779,497
" Egypt, Hides and Skins.....	3,800,000
" Nigeria, Hides and Skins	4,434,930

Markets. Great Britain, France and Germany have taken hides and skins from Africa principally; the United States receives goat skins from Morocco and part of the larger hides from the West coast and South Africa. The skins from the East coast are too small to be of commercial value in America. These hides and skins usually make up the cargo of slow-going sailing craft. Casa Blanca in Morocco, Algiers, Port St. Louis at the mouth of the Senegal, Lagos in Nigeria, Cape Town, Tamatava in Madagascar, Beira, Mombasa and Djibuti on the Red Sea, are important ports for shipping hides.

One of the most important distributing points for hides and skins is Addis Abeba, in Abyssinia, where many bundles

of these bulky goods come from various directions. From here they are sent by train to Djibuti, there to be soaked in basins prepared in the sea, in order that they may be opened and handled for baling. A full-sized bale of hides ready for shipment contains from 25 to 30 pieces and weighs approximately 450 pounds. In October, 1917, excellent skins were offered at Addis Abeba at about \$9.00 per score. The cost of transport to the coast is about \$50.00 per metric ton, or more than the ocean freight rates to America.

Outlook. The export of hides and skins from Africa during the five years preceding the war doubled in quantity. No continent unless Asia offers better prospect for increasing the pasturage for various live stock. The present percentage of 8 per cent. of world's output of hides is likely to increase more than on any other continent. Several of the native tribes appear to be particularly given to pastoral pursuits. The newly opened regions of Africa are largely in the plateau grazing lands where there is an abundance of long grass. With cheaper material for fencing an impetus is given to stock-raisers; and the larger shipping facilities following the war offer inducement to this industry, not to mention the fact that the world demand for leather never was so great. A railway from Dakar to Bab-el-Mandeb on the Red Sea would traverse a great extent of territory which is suited for grazing purposes and beyond the range of tse-tse fly ravages. The United States is rapidly increasing its imports of hides and skins and will require a larger number from Africa, particularly those suited for sole-leather.

South and East Africa have abundant wattle and mangrove bark for tanning, also chromium for the chrome process. Pasturage is abundant and leather curing seems bound to increase. The supply of hides should increase as fast as leather manufacturers can take care of them.

MEATS

Meat includes the flesh of various animals eaten in Africa. Many of the aboriginal tribes depended partly upon the natural game of the country for their food supply and occasionally varied their menu by devouring their captured enemies. A few tribes were almost wholly vegetarian in their habits; but when a protracted drought cut off their vegetable supply they

appear to have preferred to eat one another than to submit to the exertion of hunting wild animals. In sections the antelope and deer families supply an abundance of food. Elephant meat is eaten by certain tribes and many wild animals hold a minor place in the food supply, even crocodiles and other reptilia. The Kroo tribes enjoy their meats best when on the verge of decay.

Of the domesticated animals, cattle, sheep and goats are in use in parts of Africa. Among Arabs camel meat is an article of diet. Meat as a food is somewhat limited by the fact that the Koran forbids, except on feast days, the eating of beef amongst the great Mohammedan population of North and East Africa. Cattle in Africa are used more for draft animals in the northern section; for their hides and skins in the central section; for beef in the South African and Senegal regions; and for milk and dairy purposes in lesser degree in the Union of South Africa.

In Somaliland a man's wealth is measured by his flocks and herds, just as in the Old Testament the patriarch's riches were expressed in the numbers of his camels, goats or asses. In certain inland regions cattle are bred chiefly as a medium of exchange. The unit of value in purchasing a wife among many of the native tribes is the cow. A man's wife might be a three-cow wife or a twenty-cow wife, according to her charms.

There is a great demand for preserved meats of all kinds among the European population and "assimilated" natives who consume great quantities in those centers where there is no slaughtering done and while on their journeys.

In case of preferential or retaliation tariffs East Africa would have a great advantage in regard to trade with Great Britain in dairy produce, and frozen beef, over such countries as Denmark, Holland, Argentine or the United States. South and East Africa are much nearer to congested centers of population than Australia and New Zealand which export such enormous amounts of cheese, butter and frozen mutton.

While there is a large export of hides and skins from every part of Africa the carcasses for use as food do not meet the home requirements except in regions like Morocco, Senegal, South Africa, Madagascar, or Mozambique, in which beef-packing plants have lately been established, and are now exporting canned and frozen meats. Many live animals are ex-

ported from Northern Africa to Europe for use as meat, and a smaller number from South Africa and Madagascar.

At the present time the five great regions of Africa devoted to the raising of beef, mutton, or pork, are South Africa, Abyssinia, Madagascar, French Northwest Africa, the Senegal and Niger basins. In the latter region is found the Bornu ox straight backed, with enormous upright horns, apparently descended from the indigenous wild bull of Northeast Africa, while the Fulani ox is humped and has short horns, being closely related to the zebu (*Bos indicus*) of India. These cattle are inter-bred and thrive in regions beyond the habitat of the tse-tse fly. There is also a stunted, dwarfish variety of cattle which seems to be immune from the fly disease. These cattle are not used for draft animals, as in South Africa, but are often ridden and driven as pack animals.

The Kaffir tribes have ox races, riding the animals without saddles and steering them by a rope attached to a small stick piercing the nose of the ox. These native cattle will not give down their milk except in the presence of the calf, which is brought out at milking time. Occasionally a stuffed calf is used as a decoy.

In British East Africa for many years to come oxen will be the chief animal for tractive and agricultural purposes. Their size is generally small and they cost about three pounds each. For stock raising, both for meat and for working bullocks, the Hereford is considered the best animal, being extremely hardy, and maturing more quickly than the Polled Angus, another favorite breed.

Sheep and Goats. Sheep and goats thrive on the uncertain forage of the upper and lower portions of the continent, and form a standard article of animal food. On

the East Coast and Equatorial belt a species of sheep having hair in place of wool is raised for edible uses. Every colony in Africa has its species of goat, but these omnivorous animals are less numerous in the vicinity of the Equator than on the rocky highlands to the north and south. Goat meat is rank and coarse and little exported—at least under its true name—but the war has brought about a considerable export of so-called “mutton” from the Union of South Africa, British East Africa, Morocco and Algeria. Merino sheep, crossed with the native hairy species, promise a good future. Cross bred sheep yield more mutton than pure Merinos.

Among the Hindu population, which is numerous in Eastern Africa, the flesh of the goat is more generally eaten than that of cattle, on account of the historical sanctity attached to the latter animal as one of the tenets of the Hindu religion. Goat flesh is eaten in many places, kid being most highly esteemed. Though highly civilized people are prejudiced against goat meat, the flesh of the Angora is equal to mutton. Mutton is not so large an item in world commerce as either beef or pork, although it is the most nourishing and for this reason possibly not so much in demand in warm countries. Mutton tallow is used for many purposes. Tallow from the Angora goat is used largely for candles. Cat-gut, used for the strings of musical instruments and tennis racquets, is made chiefly from the intestines of sheep which are also exported for sausage casings in America.

In Somaliland leopards and jackals prey upon the flocks of goat and sheep, now that the lion has been largely exterminated. Sheep raised around the desert oases grow very fat and furnish a superior quality of meat.

Pigs do not prosper under the intense heat of the tropics where vegetable oils are much more in demand than animal fats. The Christian populations of South Africa are increasing their supply of pork, and bacon factories have recently been established. At Salisbury, Rhodesia, a bacon factory was opened in 1914; others are in operation in British, and former German, East Africa. The Belgian Congo has produced good bacon, claimed to be the finest in the world.

Pig breeding is carried on by the Europeans, as the Koran forbids it to those natives of Mohammedan faith. Mussulmans and Buddhists raise goats.

In Tunis the exportation of pork attained a value of \$81,500 in 1912, when France was the principal consumer, the failure of the potato crop having seriously affected the raising of pigs in the mother country. In Tunis pig raising is increasing slowly.

The hogs of Madagascar belong to the primitive Asiatic species having black, stiff hair. Rare in the Mussulman regions, they are found in great numbers in the central plateau near Tananarive. Hog raising is facilitated greatly in the regions where manioc, yams and sweet potatoes are raised. Lard and salt meat are exported. In 1911 an official decree forbade the killing of sows without authorization.

The number of pigs in Africa might be estimated at 3,000,000 of which one-half are in the Union of South Africa, the remainder chiefly distributed among the French element of Northern Africa and Madagascar, the foreigners in Egypt and the Chinese along the East Coast. There are many wild boars in the jungles.

INCOMPLETE SWINE CENSUS OF AFRICA

Algeria.....	(Dec. 31, 1912).....	114,000
Union of South Africa.....	(1917).....	1,300,000
Azores and Madeira Islands.....	(1900).....	93,000
East Africa Protectorate (Mar. 31, 1915).....	.....	4,000
Egypt	(1916).....	9,000
German East Africa.....	(1913).....	6,000
German South West Africa.....	(1913).....	8,000
Madagascar	(1917).....	600,000
Mauritius	(1913).....	17,000
Morocco (Western).....	(1916-17).....	51,000
Nyassaland Protectorate	(1916).....	24,000
Rhodesia	(1911).....	2,000
Swaziland	(March 31, 1916).....	9,000
Tunis	(April 30, 1916).....	10,000
Uganda Protectorate.....	(1914).....	1,000

Production by Countries. Many head of cattle are driven from Rhodesia to the Johannesburg market; in 1917 their value was £136,000. Cattle on the ranches in this country have steadily increased and exports grow with better breeding. The Rhodesia Meat Packing Company, capitalized at \$500,000, was opened in 1918. This ranch, on which there were 66,000 head of cattle, extends over 3,500,000 acres. A herd of pedigreed short-horned cattle to supply the large local demand for breeding stock is constantly kept up by importations from Great Britain.

Morocco has many rivers coming down from the Atlas Mountains, affording an abundant supply of water, a moist climate and rich soil, which furnish good pasturage, so that the country is well adapted to the raising of cattle. Van Loo, a Belgian economist, estimates that the plateau of Morocco would sustain 4,000,000 sheep, 10,000,000 goats, 6,000,000 cattle. In 1913 Morocco exported oxen to value of \$243,000.

Conditions for cattle raising on a large scale in upper Egypt are favorable. Although sheep breeding cannot be said

to be very important, the wool output doubled during the war. Sheep graze along the canal banks or are fed on Egyptian clover (berseem). The best are raised on the natural pasturage in the north of the delta and along the Mariut coast region.

Next to wine the principal exports of Algeria are sheep and oxen, also raised in Tripoli and Tunis.

On the large plateaux around Ruanda and Urunda there are millions of head of cattle and other live stock, nearly all in the hands of natives; Germans formerly took the hides, exporting about \$1,000,000 worth in 1912. The grass in this region is too long for sheep.

Senegal. There are several kinds of oxen in Senegal, the humped ox, the large ox without a hump and the small ox. The Mauretanians devote themselves almost entirely to stock-raising. The fertile meadows of the Niger and Senegal river basins afford pasturage for large herds controlled by Arabs, who migrate to and fro with their flocks of cattle, oxen, sheep, asses and camels. The two races of shepherds in West Africa are the Moors of the white stock and the Fellatahs of the native stock. Herds are owned in common by the native tribes.

Paucity of cattle in **Angola** is due to the problem of feeding them in the dry season and to the fact that cattle are not bred for milking.

Stock raising, including beef, sheep and goats, is the most important industry of **Abyssinia**. The Ethiopian steer or zebu possesses a fatty hump, and attains a weight ranging from 770 to 880 pounds. Flesh of the goat is preferred to that of the sheep and it is very cheap, being purchased for 38 cents to \$1.54 per animal.

Madagascar. The "bovine" population is one of the principal sources of wealth in Madagascar. Stock-raising is carried on almost entirely by natives who shepherd their flocks out-of-doors the year round. The most important cattle are the humped zebras from India, introduced several centuries ago and now perfectly acclimated. Their principal characteristics are a hump on the withers; long horns generally forming a lyre; fawn colored, more or less dark, thick skin with stiff hair. There is also a variety without horns called "bory", often used for hauling loads.

The height of Madagascar cattle is below the average of those of Europe; the average weight is from 600 to 700 pounds. Wild cattle are numerous in Madagascar, generally running in bands of 50 to 100 and taking possession of a valley. They fatten very easily either in the pasture or stable. The yield in meat varies from 55 to 62 per cent. net. Preparation of lards and fats for new cooking substitutes is developing appreciably. The local annual consumption of beef is estimated at 270,000 head and the export, principally to France and her colonies, at 160,000. Six factories for preserving beef are installed in Madagascar, which turned out over 8,000 tons of frozen beef in 1917, and 5,500 tons of canned beef. The industry is rapidly expanding.

Sheep raising is not very extensive in Madagascar. The species of the Island belongs to the "big tails" of Asia. The Sakalava are not sheep raisers on account of their religion which forbids eating this meat.

The frozen meat industry in South Africa took **South Africa.** rapid strides during the war and had been on a steady increase for 12 years before the war, during which time imports of beef and mutton had been reduced from \$14,239,852 to \$2,934. The fresh and frozen meat exported from South Africa increased from 17,749,873 pounds in 1916, to 47,253,956 pounds in 1917. The meat-canning industry was largely stimulated by war demands, and canned meats have become one of the important exports.

Horses Horses are not conspicuously abundant in Africa. Camels and oxen take their places. Many army and **Mules.** mounts were bred in South Africa. Horses do not thrive within the tse-tse fly belt, but are increasing in Madagascar where there are few ailments. A cross between mule and zebra produces a zulebra, immune to the tse-tse fly.

Horse raising is not an industry in Tunis, but each land-owner has a horse or mare. The horses of the north are said to be the finest in quality, resembling the Arabian steed. Mules are numerous and much used for drayage. The ass is one of the household and thrives under pitiless chastisement. He is very useful in cultivating the oases.

Two thousand head of mules were imported into Tunis during 1913. This item indicates the general situation in Africa in regard to the importation of American bred mules,

which, especially since the beginning of the war, have been shipped in considerable numbers to Egypt and South Africa. The mule and the donkey are the common beasts of burden for short hauls, while horses are more reserved for pleasure riding, sport and raids against enemy tribes. Horses do not thrive in the tse-tse fly belt but are increasing in Madagascar.

Outlook. The possibilities of Africa from the pastoral point of view seem almost unlimited. The increase of production in food supplies which the world, with an increasing population, so insistently demands, will in the immediate future call for utilization of the fine plateaux of Africa awaiting only scientific treatment, to become remarkably adapted for grazing lands. The drawbacks to stock-raising have been the occasional protracted droughts, the prevalence of the tse-tse fly in the equatorial regions, the epidemics of rinderpest, epizootia, and East Coast fever—plagues which originated across the Indian Ocean and have decimated African herds at periodic intervals. Intermittent plagues of locusts, particularly on the borders of the Sahara Desert, have consumed vegetation, resulting in a decrease of domestic grazing animals. The various diseases have been more fatal through scarcity of veterinaries. Experiment stations in all parts of Africa are devoting attention to the eradication of prevalent animal diseases, though not yet entirely successful. Stock-raising in many parts is risky and speculative. In the upper grasslands the hyena, in particular, is a serious enemy to all young domesticated animals.

Meats for export are raised almost exclusively by European colonists. The native flocks have been mostly confined to tribal consumption. Native-owned cattle are of both the hump-backed and taurine species, but are often of a poor, inferior grade known as "canners," and raised more for hides than meat. This is particularly true of Madagascar.

The native buffalo of Africa is increasing through the protection of the game laws, a conspicuous exception to the general run of wild animals.

The demand for oxen, steers and bullocks for transportation for both men and merchandise throughout South Africa is so great as to induce the raising of cattle along the seacoast and in other sections where it is unprofitable to raise sheep and goats. With the great droves of live stock in South Africa and the over-supply of meat, owing to the killing of so many

cattle for hides, canning factories are much in demand to care for the surplus. As iron and tin are found in the country in abundance, factories for making the cans may readily be started. With this combination in good working order South Africa might become one of the greatest meat-canning countries in the world. Abyssinia combines favorable qualities for stock-raising—climate, rainfall, cheap forage crops. Experts foresee a great future for Rhodesia in stock-raising and dairying and predict another Canada there. Another favorable district for cattle is the plateau west of Lake Nyassa and of the Shiré river where, at an elevation of 5,000 feet large herds are owned by natives, as also in upper Nigeria.

The Oxford Survey of the British Empire (1914) says: "There is no doubt that when railway communication with the seacoast and Lake Nyassa is established, the stock-raising industries, both European and native, will grow rapidly, both as regards the export of live stock and skins and hides."

This observation is also applicable to many other sections of grassy tablelands where there is equable distribution of rainfall.

England is chiefly dependent upon Australia for her frozen beef, but South and East Africa are only half the transportation distance from England, which gives them much advantage in the matter of cold storage food supplies.

DAIRY PRODUCTS

Milk, butter and cheese are minor products of all African countries where milk-yielding animals abound. Dairying is not a great industry in the tropics on account of milk turning sour so quickly and the lack of demand for animal fats. Many cows, particularly in Northern Africa, are not subject to "functional gymnastics of the mammary apparatus," if we may translate a fastidious French authority, but are raised for hides or as a medium of exchange. In these countries vegetable oils are preferred to cow's or goat's milk in providing necessary fats. South Africa is the most important dairying region, though East Africa is progressing steadily.

Goat's milk is in common use in the Red Sea and Mediterranean regions. The goat yields about one litre of milk per day. It is a practice to drive the flocks about the streets and milk the nannies at the customer's door. This thick milk is

considered better flavored than cow's milk by the Arabs. Not only the goat and sheep but the buffalo, camel, mare and jenny add milk to their profitableness to man in Africa and Asia.

Next to milk, butter is the most important dairy product. The Abyssinians usually churn in skins. Methods in most localities are crude and rustic but modern improvements are coming into use to facilitate butter-making. American cream separators are being introduced extensively. In Egypt, margarine, made largely of vegetable oils, was substituted for butter four-fold during the war, on account of the decrease in the supply of natural butter. Egypt exported \$30,000 worth of natural and artificial butter in 1916, and cheese to value of \$3,350. South Africa is the center of butter-making for export.

The manufacture of cheese in African countries has received great impetus by the ever-increasing demand from outside markets, and cattle countries are contributing an increasing part of the world's supply. Goat's milk makes a strong butter and a cheese with a flavor resembling Limburger. A variety of Rocquefort cheese is made from ewe's milk in Northern Africa. Milk from the camel is made into cheese by Arabs. Of the cheese made from cow's milk the Dutch Gouda is more popular than the English cheddar.

In Egypt cheese was on the conservation list during the war when cheese production fell off throughout Africa.

One of the dairy products common to India and extending to Africa, is ghee (**Hindostani ghi**), a sort of clarified butter made both from buffalo milk and cow's milk. To prepare ghee, butter is melted over a slow fire, then set aside to cool. The result is two parts. The thick, opaque, whitish portion known as ghee, representing the great bulk of the butter, is then removed. The less liquid residue mixed with ground-nut oil, is sold as an inferior ghee. The Hindu population of Africa use ghee as their commonest article of diet, as an ointment in their frequent ablutions, specifically as a lotion for the eyes, and also in religious ceremonies. Old ghee is highly esteemed for its medical efficacy in the prevention of many diseases. More than 5,000 tons of ghee were exported from Africa in 1918. Abyssinia and Somaliland are the chief sources. Jubaland is the center of production by reason of the fertile valleys. The product is shipped to the Mohammedan population on both sides of the Red Sea. Somaliland exported (1914) 800,000 lbs. of ghee worth \$135,-

000. A small quantity comes to the United States from Egypt, Abyssinia, Tripoli and West Africa.

Production By Countries. Tripoli produces butter, as well as butter substitutes made from olive or cocoanut oil. All the Somalis export dairy products. In 1914 Somaliland had an increase in exports of butter over the previous year, showing a value of \$26,000 as against \$16,800 in 1913. Tunis has few cattle, but good milking cows are found in Gabes. In 1914 Tunis exported cheese to the value of \$5,700. Abyssinia exports fresh and condensed milk, butter, ghee and cheese. In this country ewes are milked in the sheep-raising district, primarily for home use.

British East Africa and former German East Africa have a growing trade in dairy products. In 1913 German East Africa exported 752,429 pounds of dairy products, valued at \$74,000.

Dairy farming has become important in Rhodesia, where cattle are constantly being improved by breeding with imported stock. Local cheese making (chiefly Cheddar process) has greatly reduced importation. Rhodesia is predicted to become one of the great butter and cheese countries of the world. While once nearly all of the dairy products were imported, Rhodesian exports in butter and cheese increase yearly. Cattle owned by Europeans now number 500,000; many are of pure-bred stock.

Union of South Africa. The Union of South Africa dairy products have recently become important articles of commerce. Cape Town is a busy market for butter and condensed milk. In 1917 exports of butter alone had increased to 2,979,224 pounds, valued at \$953,931, as against 45,318 pounds, valued at \$14,497 in 1913, and exportation of condensed milk has increased greatly. In 1913 the Union imported 3,893,036 pounds of butter, valued at \$917,194; in 1917 the imports amounted to 26,891 pounds only, valued at \$10,468.

There are butter plants in the Union of South Africa, with up-to-date machinery. Growth of the butter trade is due largely to the Dairying Division of the Department of Agriculture and to co-operative methods among farmers. In 1916 expert butter testers were surprised at the splendid condition, appearance, flavor and texture of South African butter

that reached London. It was declared equal to the best and brought from 192s to 208s per cwt.

In 1913 the imports of cheese amounted to 5,586,244 lbs. to the value of \$814,847, while in 1917 the quantity imported was 513,306 lbs., value \$141,941. The exports of South African cheese, on the other hand, increased in the same period from 451 lbs. worth \$92, to 76,836 lbs., valued at \$26,956. Union of South Africa (1916) produced 16,000,000 lbs. of butter and 2,000,000 lbs. of cheese.

Prices. Before the Great War butter sold in South Africa at 36 cents a pound, and during the war it rose to from

45 cents to 55 cents. Fresh milk sold for 6 cents a pint before, and only rose to 7 cents during the war. Condensed milk, which was 13 cents a can before, rose to 23 cents and 28 cents after.

Cheddar cheese sold for 9d to 1s per lb., and Gouda cheese sold for 1s 5d, in April, 1919.

Outlook. The emergency of war threw Africa back on her own resources in providing the essentials of living.

Butter and cheese production was tremendously increased. Formerly great quantities of condensed milk were shipped to all the British colonies in Africa, but home production has now equalled home consumption in the matter of dairy products in several colonies, and the production promises a continuous increase. A large export may be expected from South and East Africa.

The best dairy products come from those regions where live-stock receives the best care, which is not always the case in African countries. A better output would result from feeding more alfalfa or lucerne.

POULTRY AND EGGS

The common hen (*Gallus domesticus*) is found in every country in Africa where the warm climate is peculiarly favorable to its development, though in most places it is confined to local uses. Mediterranean countries and South Africa are the exporting regions. A much larger quantity of eggs than of poultry is exported. Fowl are valuable protectors to animal and vegetable life by destroying insects so prevalent in Africa.

Eggs in Africa are used from hens, guineas, ducks, geese, peafowl, and, during the Great War the yolks of ostrich eggs

have been dessicated for use chiefly as a foundation for wholesale cooking, as in bakeries.

Hatching eggs by artificial heat in ovens was first practiced in Egypt, and it is recorded that over a century ago 100,000,000 had been so hatched in this country. Incubators have been the outcome of the Egyptian oven practice and these artificial hatchers have grown in favor throughout the world.

Eggs are packed to ship in various ways, notably in salt, cork, liquid glass or varnished, while ostrich eggs are dried. On the West Coast the yolks and whites of hens' eggs are mixed with boracic acid and shipped for preservation in this form, known as liquid eggs.

Of fowl peculiar to Africa the Guinea-fowl **Guinea and Pea Fowl.** (*Numidia meleagris*) is conspicuous. These fowl were known to Guinea and surrounding countries in very early times. In their wild state they live chiefly in morasses and are often seen in flocks of several hundred. Guineas have been domesticated and were introduced into England in the 13th century; they have since been adopted by many other countries. Guineas do an amount of good in eating harmful insects and worms, especially by destroying the tse-tse fly, so fatal to domestic animals.

Peafowl (*Pavo cristatus*), the cock of which is known for his unusually brilliant plumage, of metallic blues, greens and copper color, are said by Sir Harry H. Johnston to have originated in northern Africa, though they are common in the Orient. This gorgeous bird, emblem of vanity, has been introduced into all countries of the world for its beauty and domestic use.

Penguin eggs, twice the size of hens' eggs, are much in favor among natives in Cape Colony and German Southwest Africa. They are collected from the adjacent islands. More than 400,000 were taken from Bassen Island alone, in 1916. The eggs are palatable, nutritious, and easily digestible after boiling twenty minutes. Shipments to England began in 1908.

On the East Coast of Africa eggs of the hawksbill turtle are eaten by the natives, and in the interior eggs of various reptiles are relished as delicacies at dusky banquets.

The Union of South Africa. Poultry raising is being scientifically demonstrated through agricultural experiment stations in several African colonies. Particularly in South Africa, since 1912, immense progress

has been noted, and the establishment of many poultry clubs, which are combining fruit growing and poultry raising. Women on the farms are taking charge of this branch of farm work in rapidly-increasing numbers. The warmth, sunshine and dryness of South Africa give this region a special advantage in poultry raising. Farmers are beginning to recognize that pure bred fowl of good laying strains are one of the most profitable kinds of stock. Such breeds as Leghorn, Ancona, Minorca, Andalusian, English Game, give best results. Cape Geese are also raised.

The progress of the poultry industry is illustrated by recent figures for imports and exports of eggs. The imports gradually fell from a value of \$300,000 in 1912 to \$50 in 1917, while the exports increased from \$35,000 in 1912 to nearly \$200,000 in 1917. The export trade is now firmly established, and during the Great War South Africa furnished a large supply of eggs to England. Cape Town is the port of shipment. From October to December there is a large excess of eggs in the South African markets which is the period when there is the greatest demand for eggs in the northern hemisphere, giving a decided stimulus to production.

Egypt is the largest exporter of eggs in Africa, and Egypt has long been a contributor to the world's supply.

Several million have been sent annually to England during the war, when her exportation was restricted to that country. Domestic poultry have been raised in Egypt for many centuries and the vast number of eggs produced gave rise to a colloquial expression—"as cheap as eggs." Many ducks and geese are raised along the water courses of Egypt, where there is plenty of short succulent grass. Quail, caught in nets, constitute a large item of export, more than 550,000 being exported in 1916.

French Colonies. Morocco and Algeria produce an immense amount of eggs which are transported to France and Spain. Morocco particularly is a region where the

unskilled Mohammedan element find an easy method of eking out a meager living by the care of poultry. Tunis in lesser degree than the other colonies has supplied eggs to France, Italy and Tripoli, but this output is diminishing with improved conditions in Tripoli.

The prolific Malay and Mediterranean breeds of fowl are profitably raised in Madagascar and Mozambique.

Export Figures

1912	The Union of South Africa exported eggs, valued.....	\$ 39,000
1913	Morocco " " "	1,010,000
"	Union of South Africa " " "	47,000
1914	Tunis exported 2,149,664 lbs. " " "	30,500
"	" poultry " " "	45,500
"	Union of South Africa " " "	56,000
1915	Egypt exported eggs to the value of.....	2,424,796
"	Algeria exported eggs to the value of.....	396,229
"	Morocco exported eggs to the value of.....	974,638
"	Union South Africa exported eggs to the value of.....	103,990
1916	Egypt exported eggs to the value of.....	3,259,618
"	Egypt exported live quail to the value of.....	28,000
"	Algeria exported eggs to the value of.....	1,033,691
"	Union of South Africa exported eggs to the value of.....	182,000
"	Morocco exported eggs to the value of.....	2,200,000
1917	Egypt exported eggs to the value of.....	3,400,579
"	Union of South Africa exported eggs to the value of.....	193,000
"	Morocco exported eggs to the value of.....	3,000,000

Outlook. The great increase in the production of eggs during the war may be maintained throughout Northern Africa, but the most notable development of the poultry industry should be looked for in South Africa, where the productive period of the summer months could supply an immense amount of poultry and eggs for the European market, at a time when there is a dearth of poultry products. With the increase of refrigerating compartments in vessels, inducement for the exportation of poultry, eggs and other perishable foods increases.

BEESWAX AND HONEY

The hive bee (*Apis mellifica*), producing the commodities beeswax and honey, is classed with the insects (*Hymenoptera*). As there are many varieties of flowers in nearly all the countries of Africa bees thrive throughout almost the entire continent, especially along the water courses where blossoms are most abundant. The different flowers give different flavors to the honey, which is yellow or amber colored. Honey is gathered by natives in the Equatorial belt at all seasons and brought to the coast for shipment. The finest honey comes from the temperate zones where flowers secrete a greater amount of saccharine matter than in the tropics. Africa ranks with the United States, Chili and Central Europe as a great honey-producing region of the world.

While honey gathering as an African industry is comparatively new, honey as food has long been known to native tribes, many of whom are keen gatherers of the nectar. In

this they are often guided by a bright green bird called the bee-eater, found from Madagascar across the continent to the Atlantic. Natives do a considerable business hunting wild bees where there is no better paying field for labor. Bees have been domesticated for the honey notably in the Congo, British East Africa, Angola, Mozambique, Abyssinia and Madagascar. A favorite hive is made of straw, as straw protects the honey and wax from the sun's heat. A popular liquor made from honey is hydromel, most ancient of fermented liquors and very heady.

The chief commercial profit comes from the wax **Beeswax.** in colonies like Guinea, Abyssinia and Madagascar. The Greek Church requires candles of 100 per cent. beeswax, the Catholic Church 40 per cent. Much of the raw material for these candles comes from Africa.

Beeswax is often adulterated and has numerous substitutes, all of which are grouped under "waxes". Sealing-wax, shoemaker's wax, and grafting wax are prepared resinous substances. The chief substitute, paraffin, is separated from lubricating oils in the purifying process, and resembles bleached beeswax. Other substitutes are Japan wax, carnauba wax, pela wax, bayberry wax.

Production by Countries. In Abyssinia, bees are extensively kept and that country furnishes much of the beeswax of commerce. The natives of this country are excellent beekeepers, usually making their hives out of the hollow limbs of the baobab tree, which they thatch at one end with grasses to keep out the rain. In Abyssinia honey is largely used for making tej, the native drink, a use of the product common to most native tribes.

Bees in **French Equatorial Africa** are so numerous in places as to be considered a nuisance, and from February to June these buzzing insects completely cover the damp borders of wells and so entirely take possession, with their painful stings as weapons against intrusion, that inhabitants can draw water only at night. The natives throughout this region have many basket hives hanging from trees. In 1845 wax was the principal product of Senegal and wax cakes were exported in large quantities. The industry has lost much of its importance.

Bee-keeping has received little attention in **South Africa** in the past, but is now encouraged wherever orchards are set out. In 1918 a trial shipment of 20 cases of South African

honey to London was reported of fair quality, but more suitable for manufacturing purposes than for the table.

The Portuguese are especially adept in this industry. In their two large colonies of Africa beeswax ranks high in the list of exports. Natives bring the product down from the bush. The Mozambique Company exported 70 tons of beeswax in 1913. The war interfered with the trade, but the yearly average should not only keep up to the mark but increase, as wild bees flourish in extraordinary numbers along the Congo-Nile water-shed.

As beeswax has increased in price, bee-raising has increased in importance in Angola. The country exports both wax and honey, but pays special attention to wax, which has become the third highest item in the commercial list. The exports have reached 1,500,000 pounds per annum. The price since the beginning of the war has doubled and now sells for nearly \$60 per cwt.

Export Figures

1909 British East Africa exported beeswax to the value of.....\$	550
1913 Morocco exported beeswax to the value of.....	138,000
" Angola exported 1,790,643 pounds beeswax.....	
1914 Portuguese East Africa exported Beeswax, through Chinde, to the value of.....	30,400
" Lorento Marque, to the value of.....	1,846
" Quelimane, to the value of.....	3,157
" Mozambique, to the value of.....	3,515
" Angola exported 755 tons beeswax to the value of.....	430,000
1915 Gambia exported beeswax to the value of.....	1,611
" French Guinea exported beeswax to the value of.....	82,402
1916 Union of South Africa exported wax, paraffin and stearine to the value of.....	1,579,345
" Abyssinia exported 1,500,000 lbs. of beeswax and a considerable amount of honey.....	
1917 Union of South Africa exported wax, paraffin and stearine to the value of.....	1,956,936
" Madagascar exported beeswax to the value of.....	245,793

Markets and Prices. Addis Abeba in Abyssinia is one of the big wax markets in the world. One of several firms doing extensive business in this commodity, has a contract to supply wax for the Greek churches in Russia, which use many candles in religious services.

In October, 1917, the price of uncleaned beeswax at Addis Abeba per farasula (37½ pounds) was about \$9.75 United States money. Uncleaned wax contains from 20 to 40 per cent. impurities.

Outlook. A large amount of the wild honey and wax goes to waste annually in Africa and the possibilities of cultivated honey are very great. As demand and prices increase there is a greater quantity brought to the

markets by the inland natives. By intelligent conservation the floral regions of Africa could support far greater numbers of apiaries than are now to be found. Scientific and systematic methods of producing honey and wax will greatly increase the product of Africa.

Bees make more honey than is actually needed by themselves, and in the warm, flowering African countries the busy insects often accumulate such quantities of stores that if they are not molested hollow trees or other large cavities will be filled, and comb may be gathered three or four times a year with abundant rainfall.

The manufacture of candles from paraffin within recent years has impaired the demand for beeswax for that purpose, but the demand is said to surpass the supply at the present. The expansion of the fruit-growing industry will tend to increase the stock of domesticated bees to facilitate pollination.

SILK

Sericulture concerns itself with the raising of silk worms (**Bombyx Mori**) under artificial conditions. The first essential is a stock of mulberry trees. In Europe the leaves of the white-fruited mulberry are preferred. The quality of the leaves is important, as the worms cannot be profitably raised unless fed on good leaves. But in Africa these are not abundant.

The world production of silk was 55,000,000 pounds for 1918. China is the leading producer, with Italy and Japan contending for second place. In normal times China, Japan and India supply about 66 per cent. of the raw silk; Italy and France 19 per cent.; Asia Minor and the Levant, 15 per cent. Tripoli, Morocco, Madagascar and South Africa produce a small amount.

Wild Silk There are various native insects in South, East and West Africa which produce raw silk. But the only in Africa. silkworms of commercial importance found in a wild state belong to the genus **Anaphe** (fam. **Eupterotidæ**). Wild silk is weak and brittle and cannot be reeled like mulberry silk. It is known as "waste" silk and enters into velvet and plush. The wild silk cocoons are so scattered and the process of cleaning the crude silk so long, there is little prospect of commercial development.

These wild silk worms feed on oak, castor bean and palm leaves and are akin to those of Asia which produce "tussah" silk in China and "Eri" in India. But the native Asiatics are far more skilled in creating silk fabrics than the Africans.

Experiments in African Colonies. Since the advent of Italians into Tripoli much effort has been made toward establishing across the Mediterranean the silk industry, which is of such large importance in Italy. The city of Homs was said to have 8,500 hand looms for making cotton and silk cloth before the war, part of which was destined for Egypt and Constantinople. The silk industry appears to be promising under modern methods and is being actively encouraged by the Italian Government both in the cultivation of mulberry trees and the breeding of the most productive species of the silk worm. Under the former primitive methods the eggs were often hatched by the women in their bosoms. The silk weavers have recently migrated to America in large numbers, and in view of their ready employment and higher wages are inclined to invest their money in America instead of returning to the parent country. This migration has reduced disastrously the supply of skilled labor for this industry in Tripoli.

Not only in the northern Mediterranean colonies but also at the southern extremity of the continent near Cape Town, systematic attempts to raise domesticated silk worms by planting mulberry trees are being undertaken.

The silk industry for which the French temperament seems particularly adapted, is being fostered in the African French colonies and proves, after many experiments, to be more promising in Madagascar than in the northern or western regions, although Morocco is listed as a center of production. Silk is very common in Madagascar—most of the natives wear rabannas and lambas manufactured of silk and raffia. This weaving is done by hand by women and children and is the oldest silk manufacture in Africa, but often sleasy or loosely woven. A species of silk is also reeled from a giant spider found in Madagascar.

Sericulture is possible in Uganda and the highlands of Rhodesia, provided serious efforts are made in scientific lines to encourage it.

In Southern Nigeria, silk is known as "sanyan," and is employed by the natives for making the so-called sanyan

cloths. In the markets, the complete nests are offered for sale, though sometimes only the enveloping layers are marketed, the pupæ being previously removed and eaten as a delicacy.

Markets. The largest demand for silk comes from the United States which consumes over \$1,000,000,000 worth annually. But no silks from Africa are sent to the United States, except specimens of their silk manufactures as curios. France receives a small supply of silk from Madagascar and her Mediterranean colonies. Italy will soon import silk from Tripoli and there is possibility that England will receive shipments from South and East Africa in the not distant future. But at the present stage the industry is essentially local and almost negligible in world commerce.

An increasing number of substitutes for silk, made from wood pulp and cotton waste, have grown in favor with American women for hosiery and gloves.

Outlook. During the past dozen years many experimental stations of the English, French, Italian and German governments have been trying out this silk producing problem along the coastal regions of Africa. The wild silk, which is so abundant in many sections, does not seem able to compete with the artificial and domesticated products of the older civilizations. General conditions are favorable and may in time bring Africa into the large silk-producing continents of the world.

OSTRICH FEATHERS

The ostrich (*Struthio camelus*) was a sacred bird in Egypt long before Cleopatra's time; its feather was the symbol of justice and truth and among the nomad tribes it still stands for victory. Many carvings of the bird are found on sepulchral walls at Thebes, and its image appears in the ruins of the Temple of Karnak. Zenophon mentions the ostrich of Assyria, but it flourished and still flourishes in Africa chiefly. The wild bird is disappearing before the persecution of man, but the domesticated fowl is extensively raised for its feathers.

The ostrich is a desert bird. Ostriches dwell on the steppes near the White Nile and Blue Nile and in the interior regions. In the wild state they generally associate with zebras or larger antelopes and live in groups of four or five. The nest is a shallow pit in the sand scraped out with the feet.

Ostrich feathers obtained from wild ostriches on the border of the Sahara desert have been for centuries one of the chief commodities brought to the Mediterranean coast in the caravan. Pursuit of the ostrich is a dangerous and exciting sport. They run as fast as a horse and when enraged are more skilful with their powerful legs than a Missouri mule.

Feathers were not much used in Europe for ornamental purposes until the close of the 13th century and were first employed in military costume in the time of Henry V. They were much worn by men at the close of the 15th century, and worn by ladies first in time of Henry VIII, becoming an important part of woman's headdress under Elizabeth's reign, and ever since. They have ceased to be worn by men, unless by Knights Templar.

How Ostriches are fed on lucerne, rape and other succulent vegetation. The eggs are hatched in incubators.
Raised. During first two years sexes are indistinguishable.

The birds mature at five years when the male feathers are a glossy black and the female a soft grey with white wings and tail. There are 24 feathers in each wing. The plucking box is made very solid and just large enough to hold one bird, for the ostrich is a fierce fighter until his head is pinned against the wall, when two operators shear his wings with a few painless clips.

The principal enemy to the ostrich is the jackal. Although the camps are surrounded by wire fences five feet high jackals can leap over the top or burrow beneath.

World Production. Before the Great War the annual production of ostrich feathers was above 1,000,000 pounds. Ninety-five per cent. came from Africa. Ostriches are also raised in Argentina, Australia, Arizona, and California, in small numbers. The center of the industry in South Africa is Oudtshoorn. The taming of birds began in 1865 and for half a century the birds have been conserved by plucking the feathers scientifically and humanely. The wild ostrich was in danger of extermination, as the birds were destroyed to secure one clipping of feathers.

Grades of Feathers. Feathers are graded according to value which depends on color and length of plumes. The grades are: spadonas, or wing quills, of the cock; feminas, the wing quills of the hen which are distinguished by black patches at the crown of the plumes; primes,

the pure white plumes of the cock; fancies, or byocks, the mixed black and white feathers of the cock; and the wing coverts.

Raw feathers are shipped in bunches to markets like Paris, Antwerp, Hamburg, London, Rome, Vienna and New York. The importers scrub them with soap, then curl and gloss them. The poor and short ones are dyed. The long white ones in natural colors are the most valuable.

Production by Countries. The Union of South Africa has always monopolized the ostrich industry, and before the war the value of exported ostrich feathers

ranked next to that of wool among animal products. The war, however, made more strenuous demands for necessities than for ornaments—the ostrich industry in South Africa waned and gave place to the production of food-stuffs for men and beasts of burden.

The Union of South Africa exported ostrich feathers in:

1910.....	741,078	pounds, valued at \$11,000,000
1912.....	999,704	" " " 13,000,000
1913.....	1,023,307	" " " 14,767,935
1914.....	775,325	" " " 6,600,000
1915.....	948,945	" " " 3,818,860
1916.....	452,000	" " " 2,430,000
1917.....	219,000	" " " 870,000

Somaliland exported ostrich feathers in:

1901.....	3,851	pounds, valued at \$28,000
1911.....	1,837	" " "
1913.....	861	" " "
1915.....	453	" " " 631

Egypt exported 49,218 pounds of ostrich feathers in 1911
23,814 " " " " 1913

655 " " " " 1915

Soudan exported 36,819 pounds of ostrich feathers in 1911
12,948 " " " " 1913
1,105 " " " " 1915

Ostriches were introduced into Madagascar by an Englishman who took five couples to the island in 1902. These one-year-old birds were acclimated at Tulear, and by 1916 there were 680 ostriches. The export of ostrich feathers to London and Paris began in 1909.

Prices. From 1907 to 1914 production increased nearly 65 per cent. while the prices increased at least 10 per cent. At the close of 1913 common sorts and short stuff were more in demand than the expensive feathers, which

cost \$200 per pound. The fall in price began in 1914. No industry suffered more from the effects of the war than this. The bottom fell out of the market completely, and feathers were absolutely unsalable. The number of birds in the Union of South Africa fell from 776,313 in 1913 to 300,000 in 1918. This reduction was accelerated by the increased cost of feeding the birds and many of the camps were given over to the raising of Lucerne. Before the war first-class birds for breeding purposes brought \$2,000 apiece. So many of the ostrich farmers were facing utter ruin during the war that the Government appointed a commission in 1917 to recommend measures of alleviation.

Immediately after the war prices began to advance rapidly. In April, 1919, they were \$10 per pound, although the grade was very inferior to that before the war.

Outlook. The raising of domestic ostriches is only half a century old. During the Boer War the industry was completely disorganized, but from 1905 to 1913 made rapid progress. The Great War has given the industry a severe setback, but now prices are advancing. Female fashions are approving the use of feathers; plumes, boas and fans are coming back strong. The industry seems likely to resume its former importance, but ostrich farmers will be more guarded in their zeal and less speculation is probable. Ostrich farms are springing up in several of the British colonies and will presumably prosper.

The South Africans are jealous of this industry just as the Turks were of the Angora goat. A fine of \$500 for exporting live birds and \$25 for exporting ostrich eggs from South Africa has been imposed by the Government. Under such conditions the industry ought to prosper. The export of wild ostrich feathers from Egypt and Northern Africa has steadily declined and is not one-tenth of what it was in 1875. As wild feathers disappear domesticated birds increase.

IVORY

Ivory is the dentine of various animals, principally obtained from elephants' tusks, which are composed of three parts—the outer crust, the centre or heart of the tusk and the hollow interior. Ivory taken from elephants that have been dead for some time is of a dirty, gray color and inferior to ivory obtained from the freshly killed animal. The tusk is

valued according to size and regularity, its fineness of grain and smallness of cavity.

Commercially the tusks are divided into several classes:

1. "Heavy tusks", the most beautiful and largest, (sometimes six feet long) and weighing more than 55 pounds.
2. "Average tusks," inferior in size to the preceding.
3. "Small tusks," below 40 pounds.
4. "Bangles," which are round and furnish arm rings for the Indians and natives of the East African coast.
5. "Ball tusks," large enough for billiard balls, and having the greatest relative market value.
6. "Scrivelloes" or small pieces of ivory which are used for knick-knacks and curios.
7. Bagatelles, or very small tusks of trifling value.

Uses and By-Products. Ivory enters into many ornamental utensils, mathematical instruments, dice, billiard balls, combs, toys, chessmen, buttons, buckles, jewelry ornaments and inlays in furniture. In Japan, China and India ivory is much used for carving, and the Japanese especially make many wonderful ornaments in miniature called netsukes. Lonesome sailors on whaling voyages carve scrimshaws from tusks of different animals.

Ivory always commands full value; for there is little or no material wasted, even the dust being available for polishing, for making India ink, or for the making of "ivory jelly". Natives who cut up the tusks do not receive remuneration in money but are allowed to keep the ivory dust for which they find purchasers among cattle raisers, who believe that milch cattle will secrete milk more abundantly if they be given a solution of ivory dust.

Substitutes in the form of celluloid and vegetable ivory are common but the genuine article is much in demand.

Quantity. The annual world consumption of ivory is about 1,250,000 pounds, of which Africa supplies 90 per cent. Ivory is obtained throughout the entire Equatorial Belt of Africa, and hunting the elephant is a favorite sport of natives who capture the beasts by hurling spears, by traps, and by ham-stringing the elephant's legs. In the earlier history a considerable quantity of ivory was brought from India and Ceylon, but the present supply of Europe and the Americas is of African origin. The tusks of African ele-

phants are both larger and heavier than those of Indian elephants, and are obtained from the females as well as from the males.

Conservation Measures. During the year before the Great War 60,000 elephants were slaughtered in Africa. This alarming destruction called for prompt measures of conservation. In British East Africa tusks of female and baby elephants are confiscated by the Government, and the capture of tusks of less than 30 pounds is prohibited. Tusks in transit are often confiscated.

To avoid destruction of the elephants, the Congo Free State does not allow them to be hunted except in certain portions of the territory, and after obtaining a permit a European pays a tax of \$100 plus \$10 for an improved firearm, and \$2 for a musket. The native gives to the State a part of the ivory which may not exceed half of the total weight gathered. To protect young elephants, the export or detention of tusks weighing less than 4½ pounds is forbidden. Throughout the Congo hunting elephants is forbidden from October to May.

The caravan trade which formerly brought many tusks from Equatorial Africa across the Sahara desert for the European market, is steadily diminishing. The East and West coasts of Africa are the depots for supplying the ivory trade, the largest being Mombassa on the East Coast and Boma at the mouth of the Congo. Marco Polo, the great Venetian traveler in the 13th century, states that there were more elephants in Zanzibar and Madagascar than any other countries of the world. "The amount of traffic in elephants' teeth in these two islands is something astonishing," he wrote.

Elephants living in the regions of rocks and mountains produce a softer ivory than those living in the plains and marshes, and the softer variety is the more valuable. A considerable amount of the ivory yield comes from beds of bones which have lain untouched for hundreds of years.

Ivory of the same district will often vary greatly. While some Congo ivory is hard, brittle, white, translucent, other material from the same region will be opaque and soft in texture as that from Zanzibar; it may also be greenish tinted at the nerve centres.

Distribution by Countries. The Governor-General of French Equatorial Africa reported recently that while at the time the French first occupied this region a considerable stock of ivory existed there,

this stock has been exhausted and the ivory exports are now comparatively stationary, amounting to about 160 tons annually.

A chief export of the Uganda Protectorate has been ivory, sent mainly to England, but the trade has greatly decreased since the war began.

The yield of ivory, which was formerly the leading output of the Congo, is being reduced and has already become secondary in importance, but the increasing rise in prices will stimulate a further and more active pursuit of the elephant.

Exports of Ivory from the Belgian Congo in Tons

1912	233
1913	276
1914	295
1915	214
1916	351
1917	180

Soon all the ivory from Senegal which is not a product of the chase will have disappeared. Ivory has been exported from this country since 1789. From 1825 to 1837, an average export was about 24,212 pounds yearly; 1888-1889, the average was 6,109 pounds.

Value of Ivory Exported from West Africa in 1912

French Guinea.....	\$ 30,423
Togoland	8,555
Cameroons	127,614
Gambia	827

In British East Africa ivory, as well as hippopotamus teeth and rhinoceros horns, has for years been counted among the staple products. The last of the elephants are being driven out of South Africa where they do much damage to agriculture.

During 1913 Great Britain imported ivory from:

Egypt	2,456	cwts.
German West Africa.....	87	"
French West Africa	138	"
Portuguese East Africa	159	"
Tripoli	3	"
Congo	263	"

Imports of Ivory into the United States Average

	Weight in lbs.	Value	value per lb.
1900.....	353,423	\$ 805,386.00	\$2.28
1905.....	627,819	1,642,958.00	2.62
1910.....	592,446	1,597,287.00	2.70
1911.....	534,300	1,343,555.00	2.51

In the calendar year 1914 320,184 pounds of ivory were imported into the United States, valued at \$876,086; average value per pound being \$2.74. (Figures for 1913 were 706,705 pounds, worth \$1,796,878.)

As with other African commodities, the price of ivory **Prices.** has had wide fluctuations. The average figures per hundredweight for the quarterly sales of billiard ball pieces of all grades at the London salesrooms in Mincing Lane during 35 years, were as follows:

	Cwt.
1870	£155
1880	90
1890	112
1900	68
1905	167

Commerce in ivory in the interior of Africa is now **Markets.** carried on by caravans under conduct of Negroes or Arabs, with funds furnished by European or Hindu merchants. Very rarely the leader of the caravan operates on his own resources. The German product was chiefly shipped from Bagawayo and Pangani; the ports for British ivory are Mombasa and Kisimayu. While Bagawayo was formerly the most important of the ports, Mombasa has recently made very rapid headway.

The striking change in the location of the chief distributing point in Europe for ivory is shown by a comparison of statistics for 1908, and for a date 20 years earlier. While in 1888 the annual sales of ivory were 373 tons in London and but 6 tons in Antwerp, in 1908, sales on the London market had fallen to 214 tons, while in Antwerp 227 tons of ivory were sold. This change in markets is of course due to the large exportation in recent years from the Belgian Congo.

The supremacy of Antwerp as the ivory market is shown by figures for 1913:

Ivory Sold in 1913 (Kilograms)		
	Antwerp	London
1913	454,776	236,250
During 1919 Antwerp received 276,500 kilograms.		

The output of ivory in Africa naturally diminished **Outlook.** on account of war, but the steady reduction in the number of elephants must soon be apparent in a decreased total yield of this product because of the long period required for the reproduction of these pachyderms. In unexplored regions there are beds of ivory bones yet untouched,

but the rapid opening up of the country will disclose all sources of supply, whether from the living animals or their bleached remains. In spite of the conservation efforts a gradual decline in the ivory production of Africa may be expected. The unexplored regions in the Congo basin and the wilds of Abyssinia are the most lucrative regions to exploit. One hundred years ago, after the British discontinuance of the slave trade, ivory was the best known product which came from Africa to America. But this, today, has been superseded by ten or a dozen more profitable commodities coming out of the dark continent. It will not be many years before the elephant, like the American bison, will require most rigid protective laws to prevent his extinction.

SPONGES

Mankind obtains its supply of sponges from two principal areas—the Mediterranean and Caribbean seas. The total sponge output has a value of \$5,000,000 per year. More than one-half of this supply comes from the Mediterranean sea and nearly one-half of this latter amount comes from the African shores. Sponge fishing is an important industry of all African countries bordering on the Mediterranean and in lesser degree on the Red Sea, where quality is inferior, though quantity is abundant. The Adriatic Gulf, Aegean Sea and the coast of Tripoli produce the finest sponges. Of the African supply Tunis contributes the largest share, in value upward of \$500,000 per annum.

The sponge (*Myxospongiosis*) belongs to the *protozoa* family. The article of commerce is the fibrous skeleton which has been divested of all enveloping perishable matter. Sponges derive their value from their elasticity, the compressibility of their fibrous framework, and capacity for absorbing fluids. The finest grades are found at the greatest depths.

Production by Countries. Sponges are found on the entire north coast of Africa though the Egyptian output is comparatively slight. The Bay of Bomba produces a sponge known as the Benghazi sponge, which sells at a higher price than other African grades, but it is slightly darker in color than the sponges of the beds on the European shores, and considered inferior. The most common types found on the Tripoli coast are zimoccas and honeycombs.

The sponge industry plays an important part in the commerce of Tripoli. From the central port of Benghazi one-half of the sponge exports go to Greece, the remaining half to Tunis, Italy, France, Great Britain and America. The Gulf of Gransiste yields sponges to the value of \$150,000 per year. During 1915 there were 100 boats engaged in this industry. The Italian flag flew from the masthead of 63 ships; the Greek flag from 36 ships; Turkish, 1. Nine hundred and fifty-eight men were engaged, almost wholly Greek. During 1915, 123,-750 pounds of sponges were gathered. The price paid was \$2.10 to \$2.80 per pound for the highest grade; the poorest quality bringing 30 cents to 60 cents per pound. Sponges exported in 1902 amounted to 80,000 pounds, valued at \$120,000. The production of 1910 was valued at \$90,000. In 1908 bath sponges sold at \$6.20 per pound and cup sponges as high as \$13.65 per pound.

Tunis sponges are inferior to those of the neighboring coast of Tripoli, the average price being from two to twenty per cent. less for corresponding kinds. The natives sell their catches in the uncleaned condition in which they take them from the rocks. In 1904 the output of sponges for Tunis was 234,000 pounds valued at \$434,900. In 1915 Tunis exported 287,951 pounds of sponges, valued at \$654,435.

Algerian coasts yield only small quantities and have not yet revealed beds rich enough to warrant regular fisheries, although the elephant-ear has been found at Bona, and at other points a toilet sponge almost equal to those of the Adriatic.

The Morocco coast has been explored by Spaniards, who have found beds capable of rich commercial development.

The world demand for this serviceable commodity **Outlook.** is increasing. Industry is demanding a larger supply of sponges. The drain of centuries on the Ægean and Adriatic seas has led to extensive explorations of other sources of supply. Along the African coasts an abundant reserve supply is found in the Red Sea and off the coast of Morocco, but inferior in grade to the Greek sponge of the Mediterranean. Deep water sponges are far from exhaustion. Production of sponges by artificial culture is being tried. Measures of conservation have been enacted by French and Italian governments to avoid exhaustion of this industry, by limiting the period when sponges may be gathered.

CORAL AND SHELLS

Coral (*Corallium nobile*) is a growth of peculiar beauty found in the sea, composed of the calcareous skeletons of various protozoa. The structures built up by these minute creatures take forms like naked trees or shrubs, spread fans, flowers, mushrooms, cups, according to the different laws governing germination of the polypi of different species.

The chief corals of commerce are the delicate species suitable for jewelry and ornamental objects, and known as red, blood-red, rose, angel's skin, gray, dead, piqué. The most popular of these is the red coral (*Corallium rubrum*), a twig-like species that grows only about a foot in height and has a stem of delicate proportions.

When and Where Found. Coral is obtained along the coasts of Japan, in the Sandwich Islands, in various parts of the Indian Ocean, and in the Mediterranean region, especially along the northwestern coast of Africa, from Tripoli to Rio de Oro and on the Cape Verde Islands, where it is abundantly gathered. The most common coral is a large white species which, by its beauty and variety of form, makes fine specimens for museums, but has low commercial value. In the warm waters around Madagascar and Mozambique immense branching-trees of white coral are obtained. The red and pink coral are most important in trade, but the black coral, found near Japan, is more valuable on account of its rarity. Both the red and black coral are hard and susceptible to high polish.

Diving for coral is not so generally common as diving for sponges and pearls. Nets are often lowered into the beds by skillful coral fishermen, who are able to break off the branches without injury. Coral is bought by the weight. Large beads have sold at \$25 per pound, and extra large and fine specimens have brought almost fabulous prices.

Uses and By-Products. The red corals are the most popular for jewelry settings, because of their hardness and gloss. Pink coral has a softer, more delicate appearance when finished than red; it is also used for jewelry and is cut into globular beads for necklaces, much in vogue. Buttons made from coral are mostly from the white varieties. Buckles, brooches, bracelets and other personal

ornaments are exquisitely carved and are very costly. The Chinese and Hindus, for a thousand years, have been the most skilled artisans in carving coral ornaments.

Imitation coral, made of artificial compositions, is so cleverly produced as to require the minutest inspection to detect the substitute.

Commerce in African coral is localized in a few **Markets.** markets in Italy, the principal ones being Naples, Genoa, Leghorn and Sciacca in Sicily; a portion also goes to Marseilles. Red and pink coral is exported from the northeastern coast of Africa to India. In 1917 coral beads and ornaments were exported from Morocco to the United States, to the value of \$1,961.

The coral trade of the world was greatest in the **Outlook.** 18th and 19th centuries. Demand has appreciably decreased in recent years. While coral is still obtained and exported in considerable quantities, the showy gewgaws into which it is converted are now mostly treasured by the Hindus and the native tribes of inland Africa. On parts of the African coast there was such danger of annihilation of coral beds that laws for protecting the precious product were enacted. Algeria divided her coast into three sections in order to preserve the beautiful pink coral formerly found there in large quantities. Each division is worked five years and then allowed to recuperate for ten years. So many artificial substitutes are made there seems little likelihood of any great expansion in this industry. Its popularity depends on the uncertain vagaries of fashion. But the finest grade brings a high price today.

The plates or scales of the hawksbill turtle constitute the semi-transparent, mottled substance called **Tortoise Shell.** tortoise-shell. Tortoise shell is also obtained from both the plastron and the carapace of other sea-turtles (*Thalassites*). The most valued variety is *chelone imbracrita*. Another species, *chelone midas*, sometimes measures six feet across. This is called *tortue vert*, because of the green reflections on the polished shell. Tortoises abound particularly around the Antilles. They are found intermittently in large numbers off the coast of Senegal. The Mediterranean tortoise is used for food and for oil, as well as for ornamental purposes. Aldabra, off the East Coast of Africa, is the home of large herds of giant tortoises, the shells of which constitute an im-

portant product of commerce. The hawksbill turtle is exported from the shores of Madagascar and smaller islands of the Indian ocean, both for the shell, and the flesh and eggs for food, as well as the thick blood which is relished by many of the inhabitants.

The commercial varieties of tortoise shell are: colored shells, white shells and onglong. The French market absorbs annually \$200,000 worth of shells, but London is the greatest market.

Madagascar in 1905 exported tortoise shell to France to the value of \$25,000. In 1917 the tortoise shell export from this island was 2,100 pounds. The average price of tortoise shell at Madagascar in 1896-1897 was \$2.50 per pound. Most of the product was sent to India.

Uses. The ancient Greeks and Romans used tortoise shell for decorating doors, pillars and inner furnishings of their houses. When the city of Alexandria was taken by Julius Cæsar warehouses were so full of tortoise shell that he proposed to have it made the chief ornament of his triumph.

Tortoise shell is softened by means of boiling water, which renders it pliable enough to be moulded into any form. The lightness and softness of tortoise shell commends it for rims of spectacles, adding an ogreish look to the modern student. The shell is also employed in making veneer for boxes and frames, inlay for fancy furniture, and it is moulded or cut into snuff-boxes, knife-handles, combs and other toilet articles.

An imitation of tortoise shell is made by staining translucent horn, and the rise of the celluloid industry is producing substitutes which decreases the demand for the natural article except among the wealthy who pay high for the best.

Tortoise shells, like coral and elephants' tusks, are of slow growth and limited supply.

Cowrie Shells. The cowrie shells, of a pearl-like appearance and about the size of lima beans, are found along the East Coast of Africa, particularly in the neighborhood of Zanzibar. They were once extensively used as a medium of exchange for small values, with many African tribes, and are yet circulated in certain localities. Five dollars' worth would make a bushel.

Snails. A minor product of Africa is snails (*Helicidæ*). The supply of this delicacy varies considerably with the seasons. In Ashanti snail shells were fifth among exports for 1916. The Wam product is much sought after and obtains the highest price. In Coomassie a stick of 100 Wam snails sells at an average of two shillings.

The tropical species (*Helix pomatia*) is very large, sometimes measuring more than two inches in diameter. These snails are globular, brownish white with large rounded aperture, having a thick reflected margin. Many snails are gathered in the French colonies of Africa and exported both for food and for the shells which are valued for buttons and ornamental purposes in museums.

Although still eaten by **bon viveurs** as a garnish for spinach, chiefly among the French who display them in the markets, the snail is not valued as in former times. Romans, in the days of Lucullus, counted snails among their toothsome delicacies and kept them in moist pens where they were fattened with bran and sodden lees of wine. Snails were also formerly used as cosmetic, to preserve the soft and delicate condition of the skin. As both cosmetic and food the cherished portion seems to have been the slime.

Mother of Pearl. The beautiful mother-of-pearl which lines the shells of a great number of mollusks, and the loose, globular brilliant particles known as pearls, belong to the **Lamellibranches Gasteropodes** and **Lephalopodes** families. Mollusks are univalve, bivalve, or multivalve. Oysters, which furnish the greatest quantity of pearl, are bivalve, and belong to the genus **Ostrea**.

The pearl lining of shells, and the more prized jewels known as "true pearls," are formed by calcareous matter secreted by mollusks, evidently for the purpose of making for themselves smooth and comfortable beds in which to lie.

The shells containing this rich interior (**melagrina margaritifera**) abound in the tropical seas, and form one of the products of commerce esteemed for beauty alone. Commerce distinguishes several species of mother-of-pearl: the **Blanche Argente**, extremely clear; the **batarde blanche**, less clear, with green and violet cast; the **haliotide irridescent**; and the **burgandine**, having green reflections. The irridescent hues of certain species of mother-of-pearl are caused by the structure of the material, which is formed in very fine ridges or furrows.

These imperceptible wrinkles reflect the light in such a manner as to produce a pleasing effect to the eye.

The most valuable mother-of-pearl is found in the sea; those found in streams are of less value. The variety most sought is the Ear of the Sea (*Heliotis Gigantea*) found in greatest quantities near Japan and Korea. The flesh contained in these shells is dried for edible use. The *pinna* is found in the Mediterranean, and the *trochus* in the Indian Ocean. The most profitable regions for the mother-of-pearl are the coasts of Ceylon, Malay Islands, the Far East, eastern Africa and California. The African industry is carried on along the East Coast and on the islands of Pemba and Socotra, but more particularly in the Red Sea, where the shells are abundant. Madagascar and the Gulf of Gabes constitute a considerable market even though these regions have no organized fisheries. But the African output is almost negligible compared with other regions around the Indian Ocean.

Raw mother-of-pearl was exported from French Export Somaliland in 1914 to the value of \$5,100. Eritrea, Figures. the Italian colony on the Red Sea, carries on pearl fishing to the annual value of \$50,000, and mother-of-pearl, to the value of \$160,000.

Most of the output of mother-of-pearl is sent to France for the manufacture of jewelry, fancy inlaid work and papier-maché, toilet articles, knife-handles and other ornamental purposes, but especially for buttons, which are made from the white or cream varieties. Another shell found in tropical waters that furnishes mother-of-pearl is the nautilus, usually white, cream or faint gray.

Pearls. The same substance that makes mother-of-pearl is concentrated in jewel form in the particles which are called pearls. These particles, known as true pearls, are formed by irritating foreign substances thrust accidentally or otherwise into the shells. The fragments are enveloped by a secretion from the animal and formed into things of beauty.

How Obtained. As pearl beds are often far from the shore, pearl-diving is a hazardous and skillful trade pursued only in calm weather. Pearl-divers, like sponge-divers, are trained young. The fishers go out in boats with two sets of divers, besides the crew. When reaching the beds, half the divers, after stopping their nostrils and ears, tying a weight to one foot to assist in sinking, and fasten-

ing a net to waist and neck, make the plunge. For two or three minutes the diver stays under water, holding his breath, filling as rapidly as possible the net with oysters. Upon jerking the rope he is drawn up and assisted into the boat, usually faint and exhausted. When the first group have been again drawn into the boat, the second makes its descent, to go through the same performance, and they alternate in this way through the day, each group sometimes diving a dozen or more times. The divers frequently descend to a depth of 70 feet in their search for shells.

Shells are ready to gather when they are about six or seven years old, divers being careful to leave young shells undisturbed. When the oysters are taken to shore they are piled up and left to putrefy, as the shells can then be easily opened. When considered ready, the lottery of opening and searching begins—lottery because sometimes one shell will give up a great prize or even many valuable pearls, while a hundred others might be opened without yielding a single pearl.

Uses and Substitutes. Pearls are gathered in the Persian Gulf, Gulf of California and the Red Sea, around the Society Islands and Isthmus of Panama. Ceylon is the market where the pearl has its greatest value. The Grand Mogul possesses the largest and finest round pearl as the insignium of his office. Pearls most highly esteemed are the round ones, and compare favorably with precious stones. Small pearls, known as seed pearls, are used for jewelry and decorative purposes. Very small and irregular ones are ground into powder for sale.

False pearls are now made for industrial purposes from broken glass, powder, wax and fish glue, the manufactured articles being excellent imitations.

Outlook. The pearl, though not essential to human existence, is prized by discriminating connoisseurs. The Master alluded to its select clientage when he exclaimed: "Cast not your pearls before swine." The King of Italy makes an annual birthday present to his wife of a string of pearls. In these days of taxing luxuries, the demand for pearls is not likely soon to outrun the supply. Although the price is several times higher than before the war, the African supply will not soon run out. It is subject to the fickleness of Fashion.

The cuttlefish (*Sepia officinalis*) is found most abundantly in the Mediterranean Sea, and forms one of Africa's articles of trade. This fish has a peculiar white oval-shaped bone in the middle of its body, one surface of which is hard while the opposite side consists of a spongy substance, which, when dried and pulverized, is made into tooth-powder and used as an ingredient for medicines. It is also used by silversmiths for moulds in which to cast spoons, rings, and other articles of their trade. Burnt, or calcined, it is used for cleaning and polishing silver and other hard surfaces. A common use of the cuttle-bone is for canaries and other caged birds as a sharpener for their bills.

Another very different substance obtained from this animal is a black secretion from which is manufactured India ink, made principally in India, China and Japan, where it forms the common writing ink of those countries. A dilution of this substance, treated with caustic potash and red, is manufactured, chiefly by the Italians, into a rich brown pigment known in the markets as sepia. This black substance of the cuttlefish is contained in a bag connected with the siphon; when the animal is pursued it throws out the inky fluid which clouds the water around it, thus enabling it to escape.

The cuttlefish was considered a great table delicacy by the ancients and is still occasionally used for food, by inhabitants of the Mediterranean region.

FISH

Fishing is an important industry of many African countries, especially along the northwest coast. There is a large export to the nearby Catholic fish-eating nations of Spain, Portugal, Italy and France. Fish are obtained in greatest numbers from Portuguese Africa, Tunis, Morocco, Natal, East Africa, Mozambique, Union of South Africa. Whales come from the neighborhood of Madagascar and the southern waters of the Atlantic. Salt water fisheries are divided into deep sea and coastal. The best known African salt water fish are tunny, or horse mackerel (*Scomber*), a large coarse fish sometimes nine feet long and 1,000 pounds in weight; sardines, very small fish belonging to the herring family (*Clupæa*); and anchovy (*Clupæa encrasiclus*), another of the herring family. These small fish, on account of the vast shoals that come to the

shores to spawn during May, June and July, are caught principally with nets, by the hundreds of thousands, off the northwest coasts.

Much of the food fish obtained from African waters **Quality.** is coarse, but several of the smaller kinds are highly esteemed for the quality of their flavor, and even the coarse tunny fish has gained a wide popularity for its food properties and the oil obtained from it.

The normal tunny catch of Tunis, the main center of the trade, averages 25,000 fish. Tunny roe, salted and dried, is worth \$3 per pound. Oil of the tunny fish is used for many purposes, and is obtained by boiling the head and belly, other parts of the body being used for food.

Sardines are caught by the millions and packed in olive oil in tin cans, making one of the most popular foods known. Anchovies are packed chiefly in small barrels to be used largely for sauces.

Where fish are caught and packed in such abundance as on the north African coasts there is necessarily a great deal of waste; but fish have been found to be an excellent fertilizer, especially the head and entrails, and what was once waste is now utilized. Where there is superabundance, as with herring, whole fish are used for this purpose. Fish guano is even better for fertilizing purposes, not being so strong as the oily bodies, and is gathered and packed, either alone or mixed with body parts for the use of agriculturists. Fish fertilizer contains a great deal of nitrogen, phosphoric acid, potash and lime. Fish guano contains the same properties in a lessened degree, which makes it better for soils and vegetation.

Isinglass is a very pure gelatine, manufactured from the swimming bladders of various kinds of fish and used in confectionery; also for clarifying wine and beer.

Fresh Water Fish. Inland fishing is valuable for home requirements and in places is plentiful enough for a small export. The lakes and rivers are frequently transformed by droughts into rocky roads for highways. In the interior of the continent the lakes teem with fish, as do such rivers as flow throughout the year, but many rivers contain water during the rainy season only. Often these streams become dry even a few hours after the rains have ceased, which tends to produce an amphibious fish.

How Obtained. The modes of fishing in Africa are various—ranging from the most primitive methods of naked tribes to the best methods of civilized man. The natives, who formerly lived largely on fish, catch them with wires or traps, spear them from canoes and from banks, and also use hook and line. In British East Africa the natives have pot-shaped baskets about three feet in diameter. These are sunk into the shallow water of swamps and examined next morning when any fish contained in them are speared. The native fish-spear is an awl-like, polished prong about a foot in length, fixed in a shaft 10 or 12 feet long. The fish most often caught in this way are various kinds of catfish, and the perch. The natives also use nets, which are prohibited in some places, or at least limited, because of the great quantities of fish caught in them and wasted. This protection is especially for fresh water fish, as many kinds caught from the sea are at times superabundant; fish guano and parts of fish bodies for fertilizer, has become a separate industry at certain seasons. Fish are opened and dried in the sun, by which process they become the dried fish of the markets, constituting an important trade in all the Soudan and inland desert markets.

The principal genus of fresh water fish is the carp (*Cyprinidæ*), related to the genus *Barbus*, a sluggish kind of fish having barbules hanging from the jaws. Thirty-six specimens of these fish have been classified from various rivers of South Africa and Zambezi.

The *cyprinodon dispar*, a small inland fish found in still water, has been discovered to be of inestimable use in preventing malaria by eating the larvæ of disease-breeding mosquitoes. Scientists have introduced these fish into many waters where they have proved their value in reducing disease. The *Orphiocephalus obscurus* is a large fish that also devours mosquito eggs.

Another genus of importance is the scaleless catfish family (*Siluridæ*), containing the *Clarias gariepensis*, which attains large size, often growing to the length of three feet. This fish is one of the curious survivors of drouth conditions. Adaptation to circumstances has taught it to hibernate during the dry season in mud-holes.

One of the distinctive characteristics of the *spirobranchus capensis* is a remarkable breathing organ and a cavity in

which it can retain water, which enables it to live for a considerable time in the open air or enclosed in dry mud, another provision of nature for preservation of life during the dry season.

Scarcity of fresh water fish in the interior of Africa in certain seasons is due not only to drying up of the streams after rains, but often to wasteful customs of natives. Certain tribes have a practice of placing dams across a stream and stretching before them nets which catch the fish as they pour over the fall of water. As these dams are fixed across the streams about every two miles, few fish of a stream have a chance to survive.

A small fish of the genus *Galaxias*, distantly related to the salmon, is found in South Africa. This fish is an inhabitant of fresh water of all countries of the Southern hemisphere, an argument with scientists that lands of the southern continents were once joined together.

In Ethiopian Africa there are fourteen families of fresh water fish, all more or less used by the inhabitants, but only the *Mormyridæ* and *Gymnarchidæ*, somewhat allied to the North American pikes, are peculiar to the region.

The fishing industry is well developed in the large rivers of Africa, being a special industry of Senegal and Niger rivers, where each group of natives has its own fixed fishing region.

The Lower Dahomey lagoons and lakes teem with fish, caught in great quantities by the natives for their own use and to carry to local markets.

The plattekop, or catfish, is found in great numbers in deep pools of the Orange and Vaal rivers.

While Africa does not rank with the Newfoundland Banks, the North Sea, or coasts of Japan, as a fishing region, there is a large production for local consumption and a considerable export.

In 1916, Algeria exported fresh, dried, canned fish, and fertilizer from by-products, to the amount of \$1,121,137.

Tunis exported 1,340,669 kg. salt fish, valued at 2,729,-982 fr. in 1916.

In 1917, Tunis exported 591,871 kilos of fish, amounting to \$1,146,480.

The Canary Islanders have fished at Arguin beach from early times. A 40-ton schooner catches and prepares 3,000 kilograms of fish daily. The varieties are "mugres," a species

of cod, soles, sea-crayfish, red mullets, gurnards, sardines. Dried and salt fish are exported to France.

In 1915, Dahomey exported dried fish to the amount of \$45,531, and shrimp to the amount of \$27,040.

The Gold Coast has 5,000 canoes engaged in fisheries. The fishermen never go out on Tuesday, as that day is held sacred to the fetish of the sea. These fisheries are insufficient to supply the local demand.

Sailors from Portugal a long time ago established themselves at Angola, where their hard labor has been rewarded by the modern importance of the place as a fishery.

In 1914, Portuguese East Africa, by way of the port of Lorento Marques, exported dried fish to the amount of \$2,006, and whale oil to the amount of \$28,908, and whale by-products for fertilizer, \$2,144; through Inhambane, dried fish to the amount of \$6,168, and whale by-products for fertilizer to the amount of \$31,836. In 1918 Mozambique exported whale oil amounting to \$218,000, besides whale by-products for fertilizing.

In British East Africa fishing comes next to agriculture as an industry. This country has both salt and fresh water fish, much of which is used for home consumption, but a considerable quantity is exported as well. Much fish comes from the big lakes of that country and from the rivers, the most productive of these streams being the Tana. The native men and women of this country live so much in the water that they have been called amphibious, and of the little river that yields so much to them they say, "The Tana is our brother."

In 1917, Union South Africa exported fish amounting to £214,702, and 212,659 gallons whale oil, amounting to \$79,600.

In 1917, Madagascar exported 67,309 kilograms of fish.

A fishery very different from any other is that of Whaling. procuring those largest of earth's creatures, whales (*Cetacea*). These ocean mammals are warm-blooded and air-breathing, but because of their fish-like form and habitation in water they are classed with fishes and the industry of catching them is known as whale-fishing, though they might appropriately go under Big Game hunting. The largest species, as well as the largest of existing animals, is the group known as the whalebone whale. These whales live chiefly in frigid waters and the greatest fisheries are at Green-

land and the Falkland Islands, but in the broad southern oceans they go as far north as the southern shores of Africa.

While the whalebone whale furnishes part of the African whale industry, that most valuable to this continent is the sperm-whale, or Cachetot (*Physeter macrocephalus*). They are taken on the East Coast. The bulls are larger than the cows and have been known to measure 80 or 84 feet.

Sperm-whales live mostly in the South Pacific and the Indian Ocean. The greatest African whale fisheries are on the Carroll ground between St. Helena and Africa; also in the straits of Madagascar and north of that island.

During 1911 17,500 whales were taken in the southern hemisphere. During recent years a thousand whales have been annually captured by fishermen from Cape ports. The annual average catch of whales off the coast of Mozambique is one for each day in the year. From this latter country the single large item of export to the United States during 1915 was made up of whale oil. In reciprocity the American manufacturers sent a very increased amount of agricultural machinery, automobiles and cotton goods to this distant Portuguese colony.

Ambergris, a much prized substance for perfumery, secreted in the intestines of whales and found floating in African oceanic waters or on the shore where it has been cast, is a waxy substance, sometimes white, gray, black, or variegated like marble. A find of 100 pounds of ambergris often realizes a small fortune.

The whale furnishes a wealth of useful productions. To the Esquimaux it is a friend indeed, furnishing him with nearly everything needed in his meager life, but in temperate and tropic climes the most useful products from the whale are oil, whalebone and spermaceti. Whalebone is used for stiffening clothing, for canes, whips, brushes, and, split very fine, is woven into silk to stiffen it and make it rustle. Spermaceti is used for a high grade of candles, for waxing cartridge covers, jars in which preserved fruits are contained, and by pharmacists for various purposes. The teeth of the sperm-whale are of an ivory whiteness and hardness, and are often used as a substitute for that material. Ambergris is used in scented pastilles, candles, balls, gloves, hair-powder, pomades, and other things in which a strong scent is desired, and it is the foundation of many perfumes. The skin of the whale is tan-

ned and used for a number of purposes; the flesh and bones are used for fertilizer, so that little or none of the whale is lost to commerce. Oil of the whale and of many fishes is used for making soap.

Whale fishing off the African coasts, as everywhere **Outlook**. else, has seen better days. Whales have been ruthlessly killed for many generations and, not being prolific animals, there seems to be a near possibility of their extinction. Laws are now in force for their protection. Owing to the reduction in numbers whale materials have necessarily been reduced, substitutes for them having become a necessity in certain cases. A large whale has been known to yield 1½ tons of whalebone, and oil from one whalebone whale is sometimes obtained to the value of \$3,500 to \$7,000. In 1911 oil fetched \$120 per ton.

There is an increasing demand for whale-meat in the restaurants of the world which may shorten the supply. Few American whalers visit the South African grounds of late years owing to the decreasing fares.

BIG GAME

Interest in Africa for many years has centered in its big game. Sportsmen from every part of the world have visited this continent for the royal pastime of lion and elephant hunting. As a natural resource big game has bulked large in Africa though gradually diminishing. Every section of Africa provides some sort of game to attract the hunter but the Eastern regions, including Abyssinia, Somaliland, British and German East Africa, are the most frequented fields. The railroad from Mombassa, port of British East Africa, is the chief point of entry into the hinterland whither game has retreated before the advance of encircling civilization.

The principal animals sought by hunters include the pachyderms, elephant (*Elephas proboscidea africanus*), rhinoceros (*Rhinoceros bicornis*), hippopotamus (*Hippopotamus amphibius*); lion (*Felis leo*), leopard (*Felis pardus*), hyena (*hyaena striata*, *h. brunnea*, *h. crocuta*) and other carnivora; giraffe (*Camelopardalis giraffa*); buffalo (*Bos cafer*); zebra (*Equus zebra*); deer (*Cervidæ*); antelope (*Damaliscadæ*); crocodile (*Crocodilus niloticus*) and other reptila; ostrich (*Struthio Camelus*); giant bustard (*Otis kori*); marabou (*Le-*

toptilus Crumenifer); egret (**Egretta candidissima**), and many other birds.

The various sections afford different varieties of quarry.

In Rhodesia, according to the Oxford Survey of 1914:

"The advance of civilization has not robbed Rhodesia of a distinguished place among the big-game-hunting countries of the world. In Southern Rhodesia the advent of an energetic farming population has driven away great numbers of game from those parts of the country which are situated at high altitudes, or in the neighborhood of towns and railways, but farther afield, and in the native district, the sportsman may still encounter the elephant, hippopotamus, rhinoceros, buffalo, zebra and the larger varieties of antelope, all of which are now practically extinct, except where carefully preserved in the southern colonies. The lion and leopard still prowl around the cattle and sheep folds in remoter districts, and occasionally venture within close range of civilization."

In Nyasaland, according to the same authority:

"Animal life in Nyasaland is abundant, although big game is disappearing from the neighborhood of civilization. Certain species which are common to South and British East Africa are absent from Nyasaland, e. g. theard wolf, caracal lynx, long-eared foxes, mountain asses, oryx, antelopes, the gazelles, jerboas, and bear, secretary vulture, and ostrich. Nyasaland also differs from West Africa in not possessing any form of anthropoid ape, several monkeys, some of the smaller antelopes, and the Dorcatherium. The points of resemblance with West Africa are the presence of a peculiar civet cat, one or more genera of bats, a colobus monkey, and among birds the black and white vulturine fishing eagle. Nyasaland offers a good field to the sportsman for elephant, buffalo, rhinoceros, zebra, hippopotamus, antelope, (greater kudu, sable, eland, nyla, etc.), bush pig, wart-hog, etc. Smaller animals of the order Rodentia are abundant also bats, shrews, and in a few districts also the scaly ant-eater.

"Of the carnivora, the lion, leopard, several species of cat, the cheetah, hyena, genet, mongoose, jackal, hunting dog, weasel, badger, otter, are all fairly common."

In Somaliland, according to the Oxford Survey:

"The wild fauna is naturally more numerous, and also more varied, away from the coast and beyond the British southern frontier; but even in the maritime tracts of Guban the pasture provides food for a large wild ass and for several species of antelope, including the little dik-diks (*Madoqua phillipsi* and *swaynei*, *quentheri* is confined to the Haud), oryx (*O. beisa*), and Soemmering's gazelle, both extending throughout the country, as well as the lowland gazelle (*G. pelzelnii*) replaced by Speke's gazelle beyond the maritime hills, and, about the rocky hills, the beira (*Dorcatragus melanotis*). Hares and several species of sand-grouse (*Pterocles*), bustard, and francolins, with occasional ostriches, are also found over the maritime tracts. Farther into the highland occur the harte beeste (*Bubalis swaynei*), the giraffe-like gerenuk or Waller's gazelle (*Lithocranius walleri*) the nimble klipspringer (*Oreotragus saltator*), greater and lesser kudu (*Strepsiceros*), together with wart-hogs everywhere near water, and troops of baboons along the mountains.

"Preying on these creatures and on the flocks and herds of the Somalis a varied collection of carnivora exists among which the lion, leopard, lynx, serval and civet cats, striped hyenas, jackals and foxes should be mentioned.

"The elephant seems to be suffering gradual extinction or expulsion to the less accessible lands."

Of Sierre Leone, the Oxford Survey says:

"Sierre Leone is hardly suited to big game hunting in the ordinary acceptation of the term, the larger animals being comparatively scarce. A game license costing £25 is required. Numbers of animals inhabit the forests and bush, but few are seen; they seem to shun the invader. The

dense mangroves are the home of countless grey monkeys. There are neither lions nor tigers, but the following are to be found: elephants, hippopotami, leopards, and tiger cats, fossa,* bush cows, wild boars, chimpanzees, monkeys of different kinds, armadillos, porcupines, etc. Crocodiles of great size infest the rivers. Pythons and snakes of many varieties, poisonous and non-poisonous are found."

The fauna of **Angola** includes: Lion, leopard, cheetah, elephant, giraffe, rhinoceros, hippopotamus, buffalo, zebra, koodoo, wild pig, ostrich, crocodile and many kinds of antelope. "Jungle products," obtained chiefly through natives, are among the most important exports of Angola.

In the **Dongola** desert region is found the addax, rarest of Soudan antelopes.

The elephant, rhinoceros, and hippopotamus are still numerous in parts of **Abyssinia**. Lions of moderate size are found in the wooded mountains and of a very much larger size in the warm plains where enormous leopards abound. The guepard, lynx, hyena, wolf, wild dog and jackal may be encountered very generally. Drovers of buffalo, almost destroyed by the bovine pest in 1897, are now multiplying rapidly. In the western part giraffes are occasionally seen. The ostrich is common. The zebra is met with on the plains and the wild ass in the rocky mountains to the north. Antelopes and gazelles appear everywhere. Many species of the chamois are also to be found, among which is the diminutive dik-dik, the weight of which rarely exceeds 10 pounds. Other animals are the boar, the wild dog, badger, marten, hedgehog, gnu.

Uses and By-Products. The big game of Africa have products of intrinsic value which are greatly enhanced by

the pride of the mighty hunter returning with his trophies from the chase. The most handsome and showy skins for ornamental use are the leopard, giraffe, zebra, okapi. The skins of African animals are prepared for rugs for the homes of wealthy adventurers and the most sumptuous hotels throughout the world. The most majestic trophies of the chase are the heads of elephants, rhinoceri, lions, buffaloes, and may be seen protruding from the upper walls of the clubs and halls of men in every capital of Christendom. The skulls and skeletons are stock exhibits in every great museum. Africa has been more widely advertised through its big game than any other resource, and between the circus menagerie and the pictorial geography young America of the past generation has fondly pictured the Dark Continent as

*(*Cryptoprocta ferox*), a fine cat, peculiar to Madagascar.

one vast zoological garden. Most of the furs of Africa are too costly to be worn commonly, but American shop girls wear monkey skins when fashion dictates.

Such is the recognized value of these highly prized African skins that the pelts of the plebian cat and dog are rechristened under the grander names of lion or leopard, after ingenious artificial treatment and imitation skins are fabricated from cheap vegetable fibers which resemble animal hairs.

The camel is the only domestic animal which has no wild prototype in existence. The wild horse, ox, sheep, goat, boar, cat, are yet found in different corners of the earth, but the camel is completely subjugated by man. Our domestic cat (*Felix domestica*) is descended from the Egyptian cat (*Felix caliata*) which was one of the sacred animals.

The pursuit of seals on the islands along the southern coast of Africa is diminishing but not wholly given up. Black seals visit these islands during November when the pups are born and a few months later put out to sea again. When the yearlings return an overwhelming proportion are found to be males, which are captured for the English market. In 1917 the black seal skins sold at \$7.50 apiece in London, and the total sales amounted to \$6,000.

The African crocodile (*Crocodilus niloticus*) belongs to the man-eating species, and has destroyed as many human beings as any other wild animal in the dark continent. The crocodile, while not so numerous as formerly, yet abounds in the Congo and other tropical African rivers, and the meat from young animals is said to be palatable to natives. Formerly it was held sacred by the Egyptians, and many specimens were preserved as mummies.

Africa is the home of the anthropoid ape (*Anthropopithecus niger*), ancestor, if we agree with the Darwinians, of *homo sapiens*, biggest game animal of all. Thus Africa might contend not only with Assyria as the cradle of historic man in Egypt, but with Java of prehistoric man.

The popularity of the chase has led to alarming signs of extermination of many animals. Sixty thousand elephants were slaughtered in Africa during 1913. During the war lack of easy transportation and exciting events of the battlefields attracting the adventurous spirits of the world have resulted in a respite in hunting, which has given animals an opportunity to replenish the earth.

Skin-hunters, if unrestrained, would destroy every handsome beast in the land. Natives possessing modern fire-arms would bring about ruthless and indiscriminate slaughter, impossible with their primitive weapons. The camera and not the rifle is the better implement for hunting game in Africa, as Buffalo Jones has notably exemplified.

Big game is necessarily incompatible with agriculture. As the acreage under cultivation is rapidly increasing throughout the continent game is retreating and disappearing. Realizing the importance of big game hunting as a source of wealth the several colonies have established almost exorbitant license fees for the privilege of carrying away a few skins and limiting the number very rigidly. It was not until 1909 that the German government capitalized the financial value of its colonial game, when the large revenue to the neighboring British province led Germany to adopt a similar scale of license fees in her East African Colony.

The famous French millinery establishments **Ornithological Specimens.** are largely dependent upon Africa for their ornamental plumings. The pursuit of egrets, marabouts, herons, cranes and flamingoes, has been so ruthless as to arouse protest from American Audubon societies. Among the other birds of which the plumage is sought are the blackbird, parrot, jay and humming birds of extraordinary brilliancy.

Egrets, marabouts and other birds of valued plumage abounding on the west coast of Africa seem doomed to extermination unless the slaughter of these victims of fashion is prohibited. It is estimated that 300,000 fr. worth are exported yearly from the Niger basin representing a million birds.

Among the birds of Ethiopia are the bustard, guinea-fowl, red partridge, heath-cock, grouse, pigeon, duck, teal, curlew and woodcock. Birds of prey include varieties of the eagle family and the vulture.

In 1914, Senegal exported 214,493 live birds valued at 66,-532 fr., 173,813 kilos. mounted birds, valued at 43,453 fr.

In the marshes of Madagascar are many aquatic birds—duck, teal, hens and numerous waders. Partridges, quail, snipes and alouettes are found in remote places. Guinea fowl are found in the northwest and there are many varieties of birds in the forest. The Madagascar black parrot (*Coracopsis vasa*),

an inhabitant of all Madagascan forests, has a more musical whistle than other parrots.

As with ivory, exports of feathers are doomed to become smaller and smaller unless measures are taken to conserve the supply.

International Game Law of Africa. On May 19, 1900, an agreement was made between England, Germany, Spain, Belgium (for the Congo Free State), France, Italy

and Portugal, for the preservation of game in a zone bounded by the 20th parallel north of the Equator on the north, the Atlantic Ocean on the west, the Red Sea and the Indian Ocean on the east, and the northern boundary of German Southwest Africa and the south bank of the Zambezi on the south.*

The object of the International Agreement of 1900 is the prevention of useful animal destruction, and it specifies, among other provisions, that ostriches, marabouts, and egrets are to be killed in limited numbers only. It provides for the constitution of preserves where hunting, capturing, and killing of animals designated would be prohibited without a permit issued by the governor.

Laws for Protecting Game. Owing to past indiscriminate butchery of game different governments of African colonies have made laws for the purpose of protecting animals. These laws in recent years have become stringent and grow more so as wild animals become more scarce. Certain beasts which were almost exterminated are now wholly protected by law. In contradistinction to these laws of protection for certain wild animals, the governments offer rewards for the killing of carnivora that are destructive to human beings and other animals. In British Africa, however, lions and cheetahs, which are among the most destructive, are partially protected.

Practically every colony has close seasons for game and requires hunters to obtain a game license ranging from £1 to £50 in the various colonies. Non-residents pay more than residents for privileges, but both are limited in numbers of animals killed. Greyhounds and hunting dogs are heavily taxed. Sale of eggs and meat of wild game is strictly supervised. Shooting with lights at night is restricted.

* Those desiring to ascertain the full context of this agreement should consult Parliamentary Paper, Africa No. 5, 1900.

In Natal, game reserves, aggregating 454 square miles, are protected by the government. Shooting on Crown lands is not allowed without special permit from the Provincial Secretary.

In Bechuanaland the elephant, giraffe, eland and the ostrich are wholly protected, and the penalty for killing one of these beasts is £150, or twelve months' imprisonment. Large game of this region includes the wild ostrich, hippopotamus, rhinoceros, buffalo, zebra, quagga and antelopes. Licenses are granted only to those interested in obtaining specimens or shooting for sport, and are not allowed to any persons likely to vary from the conditions of the license. The number of specimens is limited to two of each variety.

In the Transvaal the close season for most game is from September 1 to April 14. The fees for shooting are fixed by the Administration from time to time, varying with the abundance or scarcity of game. Anyone selling or lending arms or ammunition to a native is liable to a fine of £25 or imprisonment. A permit to sell game costs £3 per annum. Poaching is punishable but is common in some districts.

Rhodesia, in the northwestern part, has 15,000 square miles set apart as game reserves. There is no close season, but game is protected from October to June by long grass, the longest in the world, which often grows to 10 feet.

In German East Africa, prior to the war, certain animals were absolutely protected, chief among which were the ostrich and chimpanzee.

The German colonial governments had awakened to the fact that large reservations should be set apart as sanctuaries for game. The railroad trip from the coast to the capital of British East Africa is now a most instructive trip through a natural zoological garden.

British East Africa, in its game law of 1909 has four kinds of licenses for hunting, two for residents. The others are the sportsman's license of £50 a year, and traveler's license, available for one month and costing £1.

No game may legally be killed in the protectorate of British East Africa without license. The sportsman's license cost £50 in 1905, which provides a certain limit of game to be killed. A resident farmer is liable to a fine if he kills in excess of this number even to protect his own crops from destruction.

Somaliland has two game reserves in the mountains to the southeast of Berbera.

In **Abyssinia**, a country replete with game, a license is required for elephant, giraffe and lion only. Naturalists find a country like Abyssinia a treasure house. The thousands of butterflies and other insects not yet classified offer fruitful field for pioneer work.

Wild Barbary sheep may be killed in the countries bordering the Mediterranean Sea.

Africa is a country of such magnificent distances **Outlook.** that much of the hunted game is yet able to flee to shelters which have not yet echoed to the hunter's rifle. As a general proposition the big game of Africa is gradually diminishing, some animals much more noticeably than others. The lion, pursued both as a quarry of the trophy hunter and as predatory vermin by the African stock-raisers, is on the wane; the elephant, whose tusks have been made an object of value by man, and because of his disregard of the purposes for which fences are erected, is doomed to a similar fate; the jackal and hyena are condemned as outcasts of the animal family by all human kind; the crocodile and alligator from their fondness for luckless humans who chance to enter their aqueous element, and the giraffe, so conspicuous and easily captured, though innocent of crimes against civilization, are passing from the stage. But on the other hand, as the lions and leopards are killed off, their prey, like the zebra, hartebeeste, the Cape buffalo, through protective laws and natural re-production, are increasing in many places. Roosevelt, after his wandering through the African game trails (1909) said there was no sport in Africa to compare with hunting the moose in Maine, because every time you fired your gun you brought down something and were not obliged warily and patiently to stalk your game in alert expectation. For years to come Africa will be the best hunting ground of the world for big game.

MINERAL PRODUCTS

The minerals of Africa have been the strongest attraction to white settlers and the chief source of wealth, amounting to nearly one-half the value of exports. Many minerals in Africa are not mined because the native inhabitants are not sufficiently advanced in civilization to give them value, although gold, tin and iron have been smelted in small quantities for centuries.

The vast continent has not been fully prospected but minerals seem to be remarkably well located and with development of hydro-electric power and transportation facilities there should be rapid increase of output as labor is plentiful. Probably the richest mineral belt in the world extends from the copper fields of Katanga through the chromium beds of Rhodesia and the gold reefs of the Rand to the diamond pipes of Kimberley.

The volcanic ranges of Italy and Sicily extend across the Mediterranean Sea to Northern Africa, creating beds of sulphur and gypsum. A large portion of Northern Africa was once submerged beneath the ocean and submarine precipitations of salt and soda were extensively formed. The Moroccan massif under projected French development, gives promise of a large yield of phosphates, iron, lead and zinc.

Minerals of which the exportable surplus dominates world markets are: Gold, 44 per cent. of world's output; diamonds, 90 per cent.; phosphates, 50 per cent.; chromium, 50 per cent. Important factors in world trade are copper, tin, coal, manganese, alabaster, asbestos and, during the war, graphite from Madagascar. Petroleum, so much in demand, has not been discovered, after careful prospecting, in appreciable amount except in Egypt near the Red Sea. Iron, the master metal, is found throughout Africa. Coal in increasing amount is being taken from the Wankie mines in South Africa and a considerable quantity exported. The Udi coalfields in Nigeria are yielding a fair grade of bunker coal for vessels.

During the last year of the war Nigeria became the third country in production of tin and Rhodesia led the world in chrome iron. But these countries may not hold these positions upon a normal peace basis.

De Launay, the French mineralogist, wrote an exhaustive book on the minerals of Africa, 1903.

GOLD

From time immemorial gold has been mined in Africa. As early as 3800 B. C., Menes of Egypt fixed the ratio of value of gold to silver at $2\frac{1}{2}$ to 1. The famous mines of Ophir in Solomon's day are said to have been in Mozambique.

The gold of Africa is found either in reefs, like the Rand, which is a bed of conglomerate as thick as 20 feet, containing deposits of ore, or in alluvial deposits which are known on the Gold Coast as bankets. The alluvial deposits are worked from above ground, often by hydraulic process; but the deep level mining is carried on by shafts which often extend a thousand feet into the earth.

The world production of gold is declining. For 1918, the output was \$377,300,000; for 1915, \$468,725,000. Africa produced 43 per cent.

How Produced. The operation of extracting gold in mines consists of (1) mining; (2) crushing; (3) extraction of the gold from ores by dissolution and smelting. Often the mechanical process of extraction is sufficient, or requires only a slight mechanical concentration followed by amalgamation and refining. The placer method consists in washing of sand in a wooden tub or pan, and subjecting the auriferous gravel to the motion of a stream, or on a larger scale the demolition of high embankments by powerful jets of water; the gold is then gathered by means of sluices, or by dredging. Metallurgical treatment of gold is constantly playing a more important part in mining low grade ores.

Gold in America is worth \$20 per ounce, but often costs more to obtain it with increased labor wages. As a by-product in silver, copper, lead and zinc mining, it pays.

The British Government saved many millions by commandeering gold for the duration of the war at pre-war prices, since the cost of production has greatly increased. The average cost of working gold per ton in 1914 was 16s 8d, and in December, 1917, it was 20s. The yield per ton averaged 1-7-1.

A 10 per cent. tax on net profits is paid to the British Government by the gold mining companies of the Transvaal.

Uses. The most essential use of gold is for currency. Mixed with copper in the proportion of 9 to 1 it is struck in the mints and circulates with a legal stamp upon it as the instrument of all international exchanges. Forty per cent.

of gold is used in the industrial arts, jewelry, gold leaf, watch chains, plate, pens, dentistry. Considerable is exported to the Far East, where it is worn on the body and hoarded.

Upon gold is based the credit of nations, and an adequate gold reserve must be provided to sustain the financial stability of the world. Adverse trade balances between countries are usually paid in gold.

Production by Countries. In Africa the principal centre of gold production and the first in the world is the Witwatersrand or Rand, near Johannesburg. The

first mines were worked in the Union of South Africa in 1885, and since 1905 this country has supplied about 43 per cent. of the world's annual output. Two hundred and twenty thousand miners are employed in the Rand mines. They receive 50 cents per day, besides food and lodging. Fifty million dollars in wages are paid out annually. Three-fourths of the laborers are native blacks and several thousand Chinese. There are 10,000 stamps at work crushing more than 25,000,000 tons of ore per annum.

The Rand in a narrow district 28 miles long produces more than £24,000,000 of gold yearly with relatively poor ores, sometimes panning out hardly 24s per ton. In proportion as the expenses decrease, the mean percentage will correspondingly fall through the utilization of great masses that are valueless today. The total production of the Rand up to date has amounted to £475,000,000.

The most profitable gold-producing area is shifting from the old central Rand mines to what is known as the Eastern Rand, where the grade of ore is better and the cost of production smaller than in the former diggings.

Working Costs of Operation of Rand Mines

Supplies	35.5 per cent. of total
Labor	59 " " "
Management, etc.	5.5 " " "

Several Transvaal gold mines were worked at a loss during the war, and would have had to close at the end of the year 1918, unless the war had ended. But there are such large properties in this part of South Africa that capitalists are endeavoring to revive the output.

In 1917 the grand output of gold for the Union of South Africa was valued at \$186,255,000, and in 1918 the value was \$174,060,000.

British East Africa, via Mombassa, exported gold in 1915, to the value of \$1,386,995.

Nigeria, in 1915, exported 1,409 oz. of raw gold, valued at \$25,000; and in 1916, 1,897 oz. valued at \$37,000.

French Somali, in 1914, exported gold ingots, valued at \$45,800.

The gold found in **Angola** is mostly mixed with other substances, but when freed is of good quality. The greatest amount is found high up on the plateau.

Abyssinia has produced gold since earliest times, but the output has never been extensive. The railroad from Addis to Jibouti will serve to promote the mining operations by reducing the hazard of transportation.

Madagascar for many centuries has carried on the gold industry to a limited extent. The natives convert their gold into personal adornment; the élite of Madagascar have been known to carry as much as 25 pounds around their necks and arms. In 1912 Madagascar produced 2,119,571.16 gr. gold.

The highest amount of gold exported from Madagascar was 3,645 kilo. in 1909; in 1917 it had fallen to 921 kilo. During the past 25 years more than 40 tons of gold have been shipped to France.

Egypt in ancient times supplied much of the gold of the world, but gold mining is a subordinate industry in this country today, though there is a small annual output, \$125,000 worth (1914). In Dongola mines are worked in more or less paying quantities.

In **Mozambique** gold fields have been worked intermittently for centuries. Singal is a modern mine not known to the ancients.

During 1913 Mozambique exported gold bars to the value of \$113,000 via Beira.

The output of gold in Manicaland has been:

1913	47,137	oz.
1914	48,984	"
1915	38,002	"
1916	35,579	"
1917	37,937	"

In **German East Africa** gold is found near Lake Victoria Nyanza. The rich ore is difficult to mine because of lack of water and wood. In 1911 German East Africa exported 992 pounds of gold, valued at \$243,580, and in 1912, 497 pounds, valued at \$126,288.

Before the war Germans controlled 40 per cent. of African gold mines. Under control of Messrs. Wernher, Beit, Eckstein and Co., was 45 per cent. of the Rand output. Nearly all the Rand mines are controlled by eight houses.

In the **Congo** gold is now exploited in two mining centers, the Katanga and Kilo groups, where the gold is obtained chiefly by hydraulic process. Three of the mines are operated by the State, and the largest output of gold comes from the State mines at Kilo. The number of gold mines is increasing in the neighborhood of Bokwana.

In 1906 Belgian Congo exported 602 pounds of gold, valued at \$171,000. In 1915 the output was 3,720 pounds.

Rhodesia numbers seventh among the countries of the world in gold output, having surpassed Mexico.

In 1914 Northern Rhodesia exported raw gold to the value of \$5,100, and Southern Rhodesia, to the value of \$17,500,000. In 1915 the Rhodesian output of gold amounted to more than \$19,000,000, of which \$18,558,500 was exported.

In 1916, the output of gold amounted to \$19,476,000; in 1917, to \$17,470,000.

West Africa is rich in gold but the climate is so unhealthful that few white laborers go into the mines. Hence the output of gold is comparatively small and decreases rather than increases.

In **French West Africa** gold is still obtained by primitive methods. Soil is extracted and placed in a gourd full of water. After several washings in a series of gourds graduated on a smaller and smaller scale, nothing remains but a black residuum containing the gold dust. This is dried and then by blowing upon it lightly gold is obtained, with a loss of one-third to one-fourth. The powder is melted and worked by smiths into torsade rings. This gold is worth about 75 cents per gram. Nuggets are extremely rare. The multitudinous superstitions connected with this industry are an obstacle to its development.

In 1917 the output of gold in French West Africa was \$7,500,000.

Senegal. In the 12th century El Edrisi, an Arabian geographer described the Senegal River as the River of Gold. Andrew Brue, director of the Senegal Company from 1697 to 1725, wrote: "Compagnon, who has been sent to explore this region believes that if the mines were exploited they would

yield much more gold than the mines of Peru." But this country never panned out according to expectations.

The **Gold Coast** is very rich in minerals, particularly gold.

The Oxford Survey of the British Empire says:

"Nature's poundings, roastings, and washings in the past ages have disintegrated the gold-bearing quartz, accumulated the precious metal thus set free, and deposited it in beds of clay. Gold, therefore, has from time immemorial been one of the principal exports of the country—hence the name—and since the pacification of Ashanti, gold-mining has gone ahead very rapidly."

In 1915, the Gold Coast produced gold to the value of \$8,-500,000, and in 1916, to the value of about \$8,000,000. The average number of laborers employed daily by the mining and dredging companies throughout 1916 was 15,296. There was no difficulty in obtaining surface labor, but there was a shortage of underground labor.

The **Ivory Coast** once seemed to be the promised land of gold and the natives still decorate themselves with great quantities of this metal. The principal chiefs are very rich, having chairs of solid gold and wearing sandals with gold soles. They are buried with gold breast-plates. On holidays persons of both sexes load themselves with very costly jewelry. Gold dust is the current money and many natives have scales for gold, with gold weights. At Baoule native exploitation of gold is active, but in Sanwi there are hundreds of abandoned shafts.

Outlook. Since the beginning of history Africa has supplied a larger share of the world's gold than any other continent and will probably continue as the leader many years. In the absence of discovery of new gold fields on a large scale, the tendency is toward a declining world's output. The world's highest production of gold was reached in 1915, when the output was valued at approximately \$480,000,000. The Transvaal share of this was 40 per cent. and the share of the British Empire 61 per cent. The percentage of the world's supply contributed by South Africa has steadily increased during the past 30 years, and reached its highest point in 1918, 44 per cent. The amount of gold mined was reduced some 10 per cent. by the war because of the high wages of labor, scarcity of supplies and mining machinery, and most notably from the terrible scourge of influenza which swept through the mining camps, and also to a reduction in the grade of ores. The Transvaal Chamber of Mines appointed an Economic Commission, which reported in 1914 that the tons

of payable ore remaining in the mines was 550,000,000. The amount taken out of the mines per annum averaged about 27,000,000 pounds. **The Cape Times** reckoned that the production would continue on the current scale only five years from that date under normal conditions, and that 17 years later the tonnage would be reduced to 14,000,000 tons per annum. During the war period many of the low grade mines through adverse operating conditions were compelled to suspend and appeal to the Government for a subsidy. A Commission was appointed to investigate the merits of the case and reported early in 1919 against Government subsidy, but a premium is paid in 1920.

The State has organized mines in which the Union Government shares in the profits. These mines have been exceptionally prosperous.

Another examination of the gold fields was made, particularly the great unopened district of the East Rand. This latter report brought the total available tonnage to 1,160,000,000, and predicted a gradual increase for 20 years, until a total of 65,000,000 tons per annum would be reached; then a pause of ten years at that figure, followed by a slow decline through three generations. Sir Robert Kotze, a South African Government mining engineer estimates the reserves of the Rand at \$2,000,000,000. Others, who are possibly promoters or share floaters, set the figure at \$3,000,000,000, which is more than the total output of the Rand during 40 years.

Gold is found in many regions in Africa in payable quantities. The desideratum in most cases is adequate transportation facilities to shipping ports. Much of the gold lies in regions unsuited to habitation by white men, but the great demand following the war for an increased gold reserve will tend to stimulate exploitation of all these regions. The sections which promise immediate development are the Katanga mines, the deposits of Rhodesia and Mozambique, and the mines of Abyssinia. The ancient goldfields of the Gold Coast show no remarkable fluctuations in annual output.

DIAMONDS

The name is derived from a Greek word meaning adamant. The diamond is the most highly prized mineral because it combines the purity and transparency of water with the

vivacity of fire. Diamonds were prized as long ago as 6000 and 7000 B. C. though at that time the pearl was the most valuable gem. They were first mined in India where they were believed to be the gift of heaven, crystallized in the earth by thunderbolts.

The sparkle of the diamond comes from cutting the stone into facets. The famous Cullinan diamond, found in 1905, weighs one and one-fourth pounds or 3,000 carats, size 4"x 2½"x2". A carat is equivalent to 205.3 milligrams.

Eighty percent of the supply of diamonds has been placed on the market since 1889. Modern demand is very great.

The total world production of diamonds up to 1920 is given as 188,000,000 carats of which Africa produced 154,000,000 carats, Brazil 14,000,000, India 12,000,000, German Southwest Africa 6,500,000.

African diamonds are divided into the following classes: Bye-waters, capes, fine capes, silver capes, Kimberley crystals, Wesseltons and Jagersfonteins; they are subdivided into four point, two point or three point stones. In cutting, the stone is first divided with a chisel according to cleavage into two or more small stones and these are faceted by grinding. When cut the diamond is held in a lathe and while it revolves is cut by another diamond. The diamonds of South Africa differ from all others in being brighter and freer from incrustation which allows detection of any defects while in the natural state.

World's Supply. The annual world's supply of diamonds is about 6,000,000 carats. Only the diamonds from South Africa are of great value as gems. Diamonds from other countries, on account of milky flaws and carbon, are chiefly used for drills and mechanical purposes. Brazil eclipsed India during eighteenth century; South Africa eclipsed Brazil during nineteenth as the diamond center.

Frank Vincent describes the formation of the diamond pipes as follows:

Diamonds were first obtained upon the surface in a yellow earth, the result of decomposition of strata. Then going down they were found in a sort of tough blue clay, a hard lava-like earth which extends to a great depth.

Hard rock containing shale has been altered by the action of heat produced by penetration of volcanic forces through it, and this heat, causing the liberation of some volatile hydro-car-

bon has produced the diamond. An outburst of heat is forced from below, resulting in the conversion of carbon into the crystalline form which we call diamonds. At Kimberley, diamonds occur in a great variety of colors, green, blue, pink, brown, yellow, orange and white.

The blue clay is hoisted by shafts into cars, then pulverized and washed in a rotary drum. The residue is cleaned by boiling in a mixture of nitrate and sulphuric acid.

How Produced. The blue clay is taken to washing machines where it is agitated with water and forced through a series of revolving cylinders perforated with holes one inch in diameter. The gravel is then sent to the pulsators—steel sieves with holes from $1/16$ to $5/8$ inches in diameter which separate the sizes. The small sizes are conveyed to a washing pan and the large ones to revolving tables where the large diamonds are taken out. The remaining stones then go to the grease shaking tables, a series of sloping corrugated iron tables coated with grease which are shaken by percussion as the gravel goes over them—only the diamonds adhere to the grease. The crystals are cleaned in a mixture of acids, then assorted, weighed and registered.

All diamonds must be registered and a severe penalty is imposed for under-valuation.

Cost of Production. It requires little capital in the “wet diggings” as the alluvial deposits on the rivers and streams are called, but the yield is uncertain and irregular. But the dry diggings or shafts are expensive to operate. One-half carat to 1600 lbs. of matrix pays. The mines are going deeper all the time making production more expensive, seldom less than 1,000 feet deep. The De Beers Consolidated Mining Company occupies 200,000 acres, employes about 15,000 natives at five to eight dollars per week, 2,500 white men at \$60 to \$100 per month, all employees being kept in a compound with no communication with the outside world. Expenses of operation are enormous. The cost of production is estimated at 10 per cent. of gross profits. The Transvaal government exacts 60 per cent. tax on all diamonds mined within its jurisdiction. About \$1.10 per ton is the cost of milling.

The diamond export duty act of 1917 provides for export duty of 5 per cent. on all rough, uncut diamonds from the Union of South Africa. During the past ten years the rate of taxation has risen from 7 per cent. to $22\frac{1}{2}$ per cent.

Relative Quality. The Kimberley mines are rich in diamonds but are characterized by poor quality and have a larger percentage of bort than other mines of that district.

The product is in fragments and sometimes smoky and yellow in color. The De Beers has all kinds and colors. The Jagerfontein mine is free from pyrites and has the purest quality of stones with a brilliancy similar to those of India. Blue "Jagers" command the highest price of any South African diamonds. Like all first water gems they are subject to bad flaws and what are termed carbon spots.

Uses and By-Products. "Bort", crystallized diamond not sufficiently transparent to cut as jewels, is used for mechanical purposes. One-fourth the yield of the Brazilian diamond fields and about 45 per cent. of the African mines consists of bort. Bort crystals of one-half to one carat are used as teeth in saws for marble and stone and as jewels for meters in electrical machines. Small pieces of bort are crushed to powder for use as an abrasive.

Small diamonds known as "glazier diamonds" are used for cutting glass; "flats" are crystals or parts of crystals into which holes are bored so they can be used as dies for wire drawing; "Splints" are sharp pointed splinters of diamond crystal obtained from refuse of cutting and cleaving and are used for small drills, for watch jewels, electrical machinery. Fifty per cent. is lost in cutting.

Carbonado or carbon is the most important form of diamond for mechanical purposes and is used in the larger operations of deep boring. Diamonds have been produced artificially by French and English chemists. They are called paste diamonds.

Prices

New York quotations for bort in 1911 were:

1 to 3 carat for drills	\$ 8.00 to \$ 15.00	per carat
½ to 1 carat for saws	3.00 to 4.00	" "
Crystals for meters	3.00 to 3.50	" "
Small and poor for crushing .....	.75	" "
Glazier diamonds	6.00 to 50.00	" "
Flats	3.50 to 8.00	" "
Splints	3.00 to 10.00	" "
Carbon	85.00 to 2380.00	" "
" 3 to 6 carats	60.00 to 85.00	" "
" 1½ to 2½ carats	45.00 to 55.00	" "
" 1 carat	35.00 to 40.00	" "

"	$\frac{1}{2}$ to $\frac{3}{4}$ carat	30.00	"	"
"	$\frac{1}{4}$ carat	15.00	"	"
"	Small	8.00	"	"

The average price of rough stones before the war was \$10 per carat. Since the war price has increased enormously.

Wages of diamond workers have been raised 20 to 30 per cent. so that the gems cost 30 to 40 per cent. more than they did two years ago.

Markets. The South African diamonds are shipped to London, Amsterdam and New York. In 1898 the value of rough diamonds imported into the U. S. was \$2,513,800; in 1908, \$2,287,440. The stones come generally from Europe to the United States. The principal center for diamond cutting was formerly at Amsterdam, but now much of the expert cutting is done in New York and London. The import trade in New York is done principally by Jewish firms. The United States is the largest buyer of diamonds in the world.

The African mines are practically under the control of the gigantic trust known as the De Beers Consolidated Mining Corporation, which so regulates the output of diamonds that the supply never exceeds the demand and thus the prices have always maintained a paying level.

When and Where Found. Ninety per cent. of the world production comes from South Africa, the leading mines being the De Beers, Premier, Kimberley and Jagersfontein. Pure stones form only 8 per cent. of the product and of this only a small percentage are blue diamonds, 25 per cent. are second water, 20 per cent. are third water, and the remainder "bort".

Diamonds were first discovered in Kimberley in 1867 and unlike all previously known deposits are found in huge pipes or chimneys filled with blue clay. As the reefs or walls of these chimneys often caved in shafts were sunk when improved machinery was introduced, and as the mines became deeper, the clay was found to be harder so that nowadays it is spread out above ground for six months or more to soften before it is crushed. All the diamond chimneys of South Africa contain the same kind of rock called kimberlite. Alluvial deposits containing diamonds exist in Orange River Colony, in the Transvaal and in German Southwest Africa; also on the watershed of Limpopo and Zambezi rivers in Matabeleland.

During the war diamond mining suffered more than most industries. From September, 1914, to January, 1916, work in the mines was almost at a standstill, but a slight increase in demand in the beginning of 1916 caused washing operations to start again on a small scale. Later in that year prosperity in the United States caused greater demand and the business became most remarkable for a time of world war.

In April, 1917, the State Mining Commission of the Union recommended the State acquisition of all diamond mines within the territory of the Union with a view to effective control of output.

In the Cape province the De Beers Company practically control all the mines, including the Kimberley, De Beers, Westelton, Bultfontein and Dutoitspan. The syndicators claim that combining these interests greatly reduces the cost of production.

The Kimberley mines were closed, to avoid over-production in 1909, and the De Beers mine was closed in 1908.

Diamond Production in South Africa

	Carats	Average value per carat
1915	103,386	\$18.32
1916	2,346,330	11.57
1917	2,902,416	12.93
	<hr/>	<hr/>
	5,352,132	\$14.30

In the Zambesi district in Southern Rhodesia are Rhodesia. large diamond pipes, worked by the De Beers Company, which, after heated litigation, was finally chartered to the right of all diamonds found in Rhodesia. The output of diamonds from Southern Rhodesia to December 31, 1908, was 7,019 carats, valued at \$155,000, from the Somabula workings. Fluctuations during recent years are shown in the following figures:

1913	997 carats, valued at \$38,000
1914	1,004 " " " 19,500
1915	272 " " " 5,100
1916	1,021 " " " 26,500
1917	620 " " " 14,600

Indications of diamonds have been found near Zambesi, Durban, Delagoa Bay, Bwana, M'Kubwa and Carnarvon.

Diamonds are found in several districts of the The Congo. Congo and there are good bearing pipes on the Kundelungu plateau which have been worked but not to make a paying industry, on account of scarcity of

labor. In 1912 machinery was taken to the Kasai district by the Societe Internationale Forestiere et Miniere, a company of Belgians and Americans, who hold the concession.

In 1915, the Congo produced 49,000 carats of diamonds

" 1916, "	" "	" 54,000	" "	" "
" 1917, "	" "	" 85,000	" "	" "

German Southwest Africa. Diamonds were discovered in German Southwest Africa in 1908 in the Coastal Desert during railway construction, and have since been found to extend over a territory 270 miles long, in the vicinity of Luderitz Bay. These deposits are believed by scientists to have been carried by the sea from a submarine diamond pipe off Pomona. These diamonds are washed from a thin surface deposit of sand gravel in places 15 feet deep. About 75 per cent. of the stones are of gold color but usually small in size, averaging five carats, very brilliant and resembling Brazilian stones. Government claimed all right to ocean floor dredging.

Up to August, 1914, about 5,400,000 carats had been extracted valuing approximately \$46,000,000, being about \$8.25 a carat. Just prior to the war, the German Government, which controlled the industry and limited the yearly output to 1,038,000 carats, received \$10 per carat, and in the last sale made by that government (1914) Pomona diamonds brought \$12.25, while others brought \$8.50.

Before the war the German Government received an annual revenue of about \$2,000,000 from African diamonds. The estimates for 1914-1915 were \$3,350,000, besides the dividends from mines directly operated by the Government, indicating the rapid expansion of the industry.

Under British occupation the output has been:

1915	13,409 carats, valued at \$ 170,000
1916	144,920 " " 1,600,000
1917	364,761 " " 4,160,000

Quantity. At the time of the African discoveries not more than 100 stones of 30 carats existed. The amount exported from Africa up to the end of 1908 was about 90,000,000 carats of which 55 per cent. was suitable for cutting into jewels. The addition to the world's stock of diamond jewels since the discovery of the African mines is 22,000,000 carats, a probable net profit to the mines of \$750,000,000.

Most of the English diamond cutting has been done in

Holland, but the Government is now trying to establish a diamond cutting factory for the employment of crippled soldiers.

Marine insurance for diamonds was almost prohibitive during the war, and a new corporation, South African Marine, Fire & General Insurance Company was formed especially for the diamond trade.

Outlook. The supply of the diamond mines seems inexhaustible. The capacity of the mines is three times the quantity that can be safely thrown on the market. The De Beers Consolidated Company is considered the most successful trust in the world, and has made immense profits. Africa will probably hold a corner in the diamond market for years to come with gradually increasing output.

The potential annual production is approximately: Union South Africa, 5,000,000 carats; Southwest Africa, 1,000,000 carats; all other countries, 400,000 carats.

COPPER

Copper (**Cuprum**), a dull-surfaced mineral having a metallic red lustre, is the most universally sought of the non-precious metals. The ore consists of copper bearing minerals and the gangue, or matrix of rock, usually carbonates or silicates. Copper combines with oxygen to form cupric oxide and with various metals to form alloys, the more important of these being bronze (copper with tin), brass (copper with zinc), and monel metal (copper with nickel). Its red color distinguishes copper from all other metals. It is malleable and ductile. One hundred and thirty-five pounds constitute a bar, 100 pounds a cake, and 20 pounds an ingot.

Copper is an electrical conductor, second only to silver.

The greater part of the world's production comes from North America which yields 68 per cent. of the whole output, the United States alone furnishing 60 per cent. of the grand total of 1,413,056 metric tons in 1917. The second largest producer of copper is Japan, 124,306 tons in 1917, an increase of 22 per cent. Copper is produced also in Canada, Mexico, Chile, Peru, Germany and Australia.

Copper output of Africa in 1917 was 48,000 tons. Production in the Transvaal, 20,174 long tons of 3.87 per cent. ore, compared with 5.44 per cent. for 1916 and 7.33 per cent. for 1915.

In 1918 Africa produced 58,000 tons, which was 3.6 per cent. of the world's total output.

The distribution of the 1917 output in Africa was as follows:

Congo	60,000,000	lbs.
Transvaal	14,000,000	"
Rhodesia	7,000,000	"
Cape Colony	7,000,000	"
German S. W. Africa	10,000,000	"
Kham	2,000,000	"
Northern Africa	1,000,000	"
	105,000,000	lbs.

Katanga. The most remarkable copper development in Africa during the past dozen years is that of Katanga. Copper in the Congo is divided into three groups, that of the coast, of Katanga and of the Ubangi. The exports of copper from Katanga in 1906 was less than eight tons, which had increased to 50,000 tons in 1918.

Copper is so abundant in the southeastern part of the Belgian Congo that thirty of the mines contain copper enough to supply the world for twenty years at the rate of 600,000 tons per year. Extraction of the ore is not difficult. The ore is found in hills from 50 to 80 meters high, which may be penetrated by horizontal galleries; except in favorable conditions miners never go further than 40 meters under ground. Motive power comes from the powerful water falls of the Lualaba, which is capable of furnishing 25,000 H. P. The Rhodesia Railway now reaching the mining region crosses the coal country at Wankie. In the Etoile du Congo it is estimated that within 100 feet of the surface there are over 200,000 tons with 11.6 per cent. of copper. The Kambove mines are reputed to contain not less than 2,000,000 at 12 per cent. copper. The output for 1913 was 7,400 tons of bar copper from 60,000 tons of ore which assays from 12 to 18 per cent. pure copper. There are three blast furnaces in operation and more under construction. Coke is manufactured at the rate of 3,000 tons per month from low grade coal. The gas produced is used for heating boilers. A number of the skilled furnace men operating the smelters were Germans who were interned during the War and whose places were taken by Welch furnace men. An electric power station is shortly to be established by making use of the Falls on the Lufria river near Coney, providing 20,000 H. P. during the low water period.

Copper mining has taken rapid strides during the last half dozen years, and this commodity soon will be the leading export from the **Belgian Congo**. Katanga derives its industrial importance from the great copper deposits. About 40 per cent. of the shares of the big Belgian mining companies are owned by British capitalists. It is estimated that the ore of the Katanga mines above the water level is over 40,000,000 tons, averaging 8 per cent. copper. Besides the mines already in operation there are at least 150 copper deposits of promising importance not yet exploited. Near Katanga carbonate and

silicate of copper are found, and lead is frequently extracted with the copper. The cost of copper landed at Antwerp varies from £36 to £40 per ton.

In the Belgian Congo, the Katanga Mines, L'Union Miniere du Haut Katanga, were operated continuously during the war, practically all of the output coming from the ores of two mines, the Star of the Kongo and the Kambove. Wood is used for power purposes and coke for smelting. Large quantities of ore have been found to be of low grade and a plant is being constructed for the treatment of these ores by leaching and the electrical deposition of the copper; this plant will have a yearly capacity of 50,000 tons of copper. The program of expansion and development up to 1921 provides for an expenditure of \$15,000,000. The company employs 450 Europeans and 7,000 natives.

The Union Miniere mine went through the war period without the loss of a single day's work by labor strikes. There are many other copper deposits not yet exploited and British capital is making rapid inroads into this region.

The Tanganyika Concessions Company produces three-quarters of African copper and is increasing in importance. The Katanga ore contains 15 per cent. copper and yields 96 per cent. of blister copper. The mining belt is at an altitude of a mile, in a healthful region, with good labor supply. A new railroad from Katanga to Benguella, soon to be completed, will materially reduce the cost of transportation and increase the output.

Cost of Production. In Katanga mines, only bonanza ores of upper levels were formerly mined. Now low grades are being mined. Cost depends on character of the gangue, whether or not it is self-fluxing. The cost of production has been cheapened by bessemerizing. The cost of production of ore in Australia (1907) was \$2.54 per ton, and in Arizona \$5.00. The cost of production in Katanga is less than in Japan but more than in America. Transportation is a large item of cost in mining alluvial deposits on top of the ground. African blister copper can be delivered in London at about the same price as American.

Katanga Copper was landed in Antwerp:

1913	at less than	\$200	per ton
1917	"	250	" "
1918	"	300	" "

Katanga copper, before the war, was shipped to Germany but since the war began it has been sent to the United Kingdom.

Prices. Prices for 1917 showed wide variations until a fixed price of 23½ cents was established by the American Government, September 21, of that year.

	Average Price Realized.
1905	15.597 cents per lb.
1906	19.146 " " "
1907	18.043 " " "
1908	13.348 " " "
1909	13,211 " " "
1910	12.960 " " "
1911	12.657 " " "
1912	15.841 " " "
1913	15.222 " " "
1914	13.458 " " "
1915	17.299 " " "
1916	25.710 " " "

The production of copper by the Union Miniere as follows:

1911	997 tons
1912	2,492 "
1913	7,407 "
1914	10,722 "
1915	14,054 "
1916	22,149 " (with 5 smelting furnaces in operation)
1917	27,463 "
1918	22,000 " (estimated)

The natives use copper to embellish their weapons, and in the making of toilet ornaments, jewelry, and for money.

Production in Other Countries. Copper is quite generally diffused throughout Africa. In the Union of South Africa this mineral was mined centuries ago by the natives for ornamental use. In 1913 the yield amounted to 4,420 short tons, valued at \$2,200,000; and in 1917 the export of copper, copper ore and regulus was valued at 5,500,000. In 1915, the Union of South Africa had copper output of 28,970 tons, valued at \$5,200,000, and 1916, 22,842 tons, valued at \$5,600,000. Only 500 tons in 1918.

In Angola there is an abundance of copper and copper mines have been worked to small extent since 1879. Copper offers great possibilities in this region.

Conglomerates holding oxidized copper ores are found in Angola near the railway line 12 miles from the Cuanza River

and at Senze do Itombe three-fourths of a mile from the railway running to Loanda.

In **German South West Africa** the mining of copper is constantly increasing at Otavi and near Kangrube. For 1913, the Tmesub mine output of copper ore was 54,100 tons, and 665 tons of matte.

A shipment of 100 tons sent to Germany from the Otyizongati mine in **German S. W. Africa** yielded 18 per cent. copper.

Algeria mines copper to a considerable extent. Owing to the rapid growth of wine making in Algeria the market for copper sulphate has been constantly expanding, and is likely to continue.

In 1913, Algeria exported to France 1,340,000 pounds of copper, valued at \$160,000; 1915, 300 metric tons copper, valued at \$80,867; 1916, 1,098 metric tons, valued at \$116,572.

In **Upper Egypt** copper mines are worked in Dongola.

A so-called "mountain of copper" exists in the upper Nile region of **Egypt** but the deposits are undeveloped; near Brazzaville in French Congo, at Gabon in French Equatorial Africa, in **German S. W. Africa**, Morocco, Natal and Tunis, and in various parts of Rhodesia copper appears.

In **Tunis** a small amount of ore is smelted into high-grade matte.

Before the war copper was exported from **French Equatorial Africa**, chiefly to Belgium. This export in 1913 amounted to \$125,000.

In **Rhodesia** experiments have been made at the Falcon Mine in producing copper plate for use in the crushers. These plates could be produced considerably cheaper than the imported article during the war.

The African World of September 29, 1918, says copper output is greatly increased in **Rhodesia**; 2,950 tons in 1918.

The production of copper in Rhodesia in 1906 was but 17 tons though many copper discoveries have been made there.

In **Mozambique** the copper output for Manica and Tete for 1917 was 307½ tons, valued at \$150,000.

For half a century **Namaqualand** in Cape Colony has been a notable producer—situated 300 miles north of Cape Town. Annual production at Namaqualand, Cape Colony, is about 7,000 tons. The Ookiep deposit here is remarkably rich, averaging 21 per cent., but is said to be nearly exhausted.

In Madagascar the copper mines were formerly exploited by the Government in the district of Ambositra. Beds of the same metal have been found in the region of Betafo, in the Vonizongo and near the lake of Kinkony in Boeni. Various deposits have been discovered in the northeast, from which much is expected.

There is an abundance of copper in Africa. An Outlook. American mining engineer who has traversed afoot

the heart of the continent, reports that there is enough copper in the Katanga region to supply the entire demand of the world for 20 years. On account of the distance from the congested manufacturing districts of the world and the cost of transportation, these deposits are not likely to be exhausted until the American and Japanese supplies have been depleted. The ratio of increase that has arisen so rapidly during the past ten years was due to the requirements of the war and is not likely to be so marked in coming years. The Katanga region is pre-eminently the most promising, and with the new railroads coming in from the West Coast will result in the largest increase from this district. Production for all Africa fell off during the war but will soon far surpass previous output.

TIN

The world's production of tin has remained practically stationary of late years. Prior to the war the annual output was about 125,000 tons. The figures for 1917 are:

Malaya	39,833 Tons
Bolivia	25,754 "
Banka	13,246 "
Siam	9,000 "
Cornwall	4,100 "
Billiton	5,000 "
Nigeria	6,510 "
China	9,133 "
Spain and Portugal	750 "
Australia	4,632 "
South Africa	1,632 "
India	1,200 "

Total 120,790 Tons

Under war pressure Nigeria, in Africa, rose to third place as a producer of tin, surpassed only by the Straits Settlements and Bolivia, in 1918. Nearly all tin produced is consumed in

the manufacture of tin plate. The commonest impurity in tin is iron.

Nigeria. Nigeria stands first in African countries as the producer of tin, and the chief mineral wealth of the Colony is tin. The industry, like that of iron, was carried on by the natives from time immemorial, and the process of smelting the tin was held a secret in the royal family for many generations.

Tin is mined by the natives, who use sluices in the streams, shifting the ore from one calabash to another.

The tin was smelted into thin round rods and used as an article of commerce. The English first undertook the working of tin mines in 1902. This tin was found to contain 80 per cent. of tin dioxide equal to 64 per cent. of metallic tin. During the period immediately preceding the war nearly a hundred separate companies were floated to exploit the tin mines. At present there are 43 companies listed on the public exchange. There has been a good deal of the customary swindles of the public where wild-cat mines have been "salted" and imaginary shafts have been sunk by companies in London advertising with metals borrowed from neighboring mines.

The mines are located in the western part of Bauchi province, at an elevation of 3,000 feet, in the midst of a mountain range, which is the water-shed for three large rivers. The large rocks of granite, basalt, and gneiss have been eroded by centuries of rain and the tin concentrates washed into the river beds. Alluvial tin is found during the dry season on the bottom of the river beds.

The entire stanniferous area is honeycombed with pits.

This Bauchi province is peopled by shy and timid pagan tribes who are very backward in being initiated into the art of scientific mining. The scarcity and distance of the villages and of food supplies for man and beast is one of the many drawbacks. The railroad chiefly used for the transportation of tin is one opened by the Niger company between Loko and the sea coast, a distance of 180 miles.

In addition to old mines not yet exhausted, new discoveries of tin have been made, and the area workable of this metal is known to extend over 9,000 square miles. Fifty tin mines are in operation.

In the matter of fuel, oil is preferable, but owing to the high railroad rates it is expensive. The newly developed coal

fields of Udi supply fuel which is hardly profitable to use in the tin mines. Timber is the most practical fuel and exists in large quantities in the southern territory.

The regulations for staking a claim are as follows:

The Government requires a prospector to take out a prospecting license at £5 per annum which entitles the holder to prospect in any part of the Colony not already taken. As an alternative an exclusive license to prospect within a given area of not more than 16 square miles, the fee being £5 per square mile. Mining leases are granted to the holders of these permits. The Government demands that some prospecting operations must have been carried on in some part of the area applied for, and also that the holder of the right can command sufficient capital to ensure the effective working of the same. The lease granted is for 21 years with option of renewal. For alluvial mining leases the rent is 5s per acre per annum, over an area of not more than 800 acres. For a lode mining lease a rental of £4 a claim of 80,000 square feet is charged per annum. A lease along a stream is granted at a rental of £1 per 100 yards per annum. The maximum distance granted is one mile.

Principal Companies Registered for Working in Northern Nigeria	Capital
Anglo-Continental Mines Co., Ltd.	£200,000
Benue (Northern Nigeria) Tin Mines, Ltd.	60,000
Bisichi Tin Company (Nigeria) Ltd.	200,000
Champion (Nigeria) Tin Fields, Ltd.	50,000
Corona Tin Fields, Ltd.	9,500
D. S. R. Syndicate	6,000
Darymusu (West Coast) Development Co.	25,000
Fulani (Nigeria) Tin Mining Co., Ltd.	80,000
Gel Tin, Lode & Alluvial Co., Ltd.	100,000
The Geri Tin Syndicate (Northern Nigeria) Ltd.	10,000
Gurum River (Nigeria)	125,000
Jauro Syndicate of Nigeria, Ltd.	3,500
Jos Tin Area (Nigeria) Ltd.	110,000
Juga (Nigeria) Tin & Power Company	275,000
Kano (Nigeria) Tin Areas, Ltd.	200,000
Kaffin Tin Company, Ltd.	10,000
The Lafon River Areas, Ltd.	50,000
Lucky Chance Mines, Ltd.	75,000
Naraguta (Nigeria) Mines, Ltd.	175,000
Naraguta Extended (Nigeria) Tin Mines, Ltd.	160,000
Nigerian Tin Corporation, Ltd.	100,000
Northern Nigerian (Bauchi) Tin Mines, Ltd.	225,000
Northern Nigerian Trust Co., Ltd.	100,000
Northern Nigerian Mining & Exploration Co., Ltd.	10,000
Rafina (Nigeria) Tin Co., Ltd.	100,000
Rayfield Syndicate, Ltd.	20,000
Rein River (Nigeria) Tin Mining Co.	76,000
Ropp Tin, Ltd.	30,000
South Eukeru (Nigeria) Tin Co., Ltd.	50,000
Sybus Syndicate	10,000

The Teria Tin Mines, Ltd.	40,000
Tin Areas of Nigeria, Ltd.	60,000
Tin Fields of Northern Nigeria, Ltd.	100,000
West African Mines, Ltd.	100,200
Zuma Tin Areas (Nigeria) Ltd.	60,000

—(From Tin Deposits of the World by Sydney Fawns)

1913, Nigeria exported tin ore to the value of \$2,763,125.
1914, " " " " " 3,439,492.
1915, " 6,535 tons of tin ore, valued at \$3,520,454
1916, " 7,054 " " " " 4,100,000
1917, " 9,966 " " " " "

Union of South Africa. The Union of South Africa ranks next to Nigeria in the output of tin, especially in the Transvaal which, since 1907, has become a considerable factor in the world's tin product.

The tin in the Transvaal is mined from veins between red granite and sandstone, and no alluvial deposits have been found. There are four producing mines in operation, with ten stamps, with an average monthly output of about \$145,000. The output in 1910 was estimated at \$3,455,000. According to the Dominions Royal Commission, 1918, "The tin area in the Transvaal has been hardly more than scratched. There is ample room for large and profitable developments."

Alluvial tin has been found in Cape Colony and Swaziland. At Kuils River, 16 miles from Cape Town, is the property of the Alluvial Tin Fields of Africa which has improvements in prospect and which estimates that the profit in sight is \$1,000,000.

A tin mine is located in Stellenbosch district in the Cape of Good Hope, operated by hydraulic plant.

Union South Africa Exported in 1917:

Tin ore and concentrates	\$1,388,437
To Straits Settlement	1,362,114
To United Kingdom	13,845

1913, South Africa had an output of tin amounting to 3,260 short tons, valued at \$1,700,000; 1915, 3,441 tons valued \$2,500,000; 1916, 2,557 tons, valued at \$1,162,558; 1917, 2,690 tons, valued at \$1,388,740.

Much of the tin exported from South Africa is destined for the United States. It is first sent to Singapore to be smelted.

Congo. Tin is found in the Katanga zone, extending 100 miles along the right bank of the Lualaba river. It is estimated that the amount of this tin is 20,000 tons. In 1906 the export of tin from Katanga amounted to

5½ tons, and in 1915, to 8 tons. The tin veins are composed of quartz and cassiterite. Tin is also found at Kasai and Thimbiri. Alluvial deposits of tin exist also in the Tanganyika Concessions, the most important being the Busanga Tin Mine, but the sleeping sickness has so far prevented the full investigation of these discoveries. Tin is also found on Busanga Ridge in lodes and quartz reefs. This mine is well situated as to water privileges.

The Union Miniere has an alluvial tin area at Bukama, the head of the railway under construction from Kambove. A plant for extracting, condensing and smelting the ore is already on the spot. The tin mine at Muika ceased operation during the war. Tin exists at Kiambi, which gives fair promise of being of considerable value. The proximity of these areas to the river Lualaba offers reasonable means of transport.

In German Southwest Africa a new tin district has been discovered between Swakopmund and Windhoek, 94 miles from the coast.

In 1913, German Southwest Africa exported tin to the value of \$170,000.

Cost of Production. The cost of production of tin from alluvial deposits is much less than from other kinds as no machinery is necessary. Expenses attached to Nigeria tin properties were as follows (1914) :

Cost of washing tin, six pence per yard by hand sluicing.

Transport, at most, £25 per ton. Smelting and incidental expenses £9 per ton. Government duty 5 per cent. on output.

With a hydraulic plant washing expenses will be reduced to less than one penny per yard; completion of the railway will reduce freightage from the mine to England to less than £20 per ton.

By these figures an average property can produce tin in Nigeria and deliver it in London at a maximum cost of £50 per ton, which leaves scope for handsome profits.

The financial success of all alluvial tin fields depends mainly on the values of the tin alluvium, the cost of extraction, and the price of the pure metal.

In 1916 the working cost in Nigeria was about \$50 per ton. Twenty thousand natives were employed in 1916. The average profits in 1918 were 8 per cent.

Average Tin Prices New York

1910 .....	.34 cents per lb.
1911 .....	.42 " " "
1912 .....	.46 " " "
1913 .....	.44 " " "
1914 .....	.35 " " "
1915 .....	.38 " " "
1916 .....	.43 " " "
1917 .....	.61 " " "
1918 .....	.65 " " "

\$1,700 per ton for Nigerian tin in June, 1918, was a record price.

Outlook. The statement has been made that Northern Nigeria is the "richest tin field in the world," but this is evidently the exaggeration of an exuberant amateur. Alluvial tin mines are usually short-lived, but there appears to be sufficient alluvial ground to employ the energies of eighty companies for the next ten years. Experts contend that lode formations exist in Nigeria.

The future of the tin industry seems favorable in Nigeria, Congo and South Africa. The water question is of first importance in tin mining and has not always been satisfactory. Laborers are abundant though unskilled. Many of them are cattle herders and cannot be depended on for permanent employment. But there are 17,000,000 natives to draw from in Nigeria.

IRON

Iron comprises 95 per cent. of the world's production of metal. It is the most useful of all and occurs throughout the world. The total production for 1918 was 80,000,000 tons; for 1916, 72,000,000 tons. In 1890 the production was 27,000,000 tons. The United States produces as much pig iron as all the rest of the world.

Countries producing iron ore in order of importance are the United States, Germany, France, Great Britain, Spain, Russia, Sweden, Luxembourg, Austria-Hungary, Cuba, Newfoundland, Algeria.

Africa produces about 2,000,000 tons of iron per year. Algeria is the principal country, yielding marketable iron; 850,000 tons in 1918.

The iron of commerce is obtained from the following ores: hematite, a red oxide, which supplies more than half of the world's supply; limonite, a brown ore; magnetite, the mag-

netic ore; and siderite, the carbonate. Wrought iron is the purest form of the metal. Steel contains a portion of carbon, but not so much as cast iron. Iron pyrites, or "fool's gold," is not useful as a commercial ore, on account of the sulphur which it contains.

Iron ores found in Africa are principally hematite, Algeria being the main source. The meteorites, coming from super-terrestrial sources, found in Africa contain a great percentage of magnetic iron.

Uses of Iron Ore. From iron ore are manufactured cast iron, wrought iron and steel. Silicon, carbon, chromium, nickel, manganese, tungsten, sulphur and phosphorus are added to iron ore in small quantities, never over 5 per cent., to give the iron hardness, elasticity, durability, density, porosity, malleability, fusibility and resistance to corrosion.

Prices of Mesabi ore were \$2.50 per ton for Bessemer and \$1.75 for non-Bessemer at Lake Erie docks in 1894. Prices rose irregularly to \$3.50 and \$4 per ton up to 1903.

	Bessemer	Non-Bessemer
1910	\$4.75	\$4.00
1913	4.15	3.40
1917	5.70	5.05

The latter price was fixed by the Government for 1918.

Production by Countries. Iron is found in the four corners of Africa. It is known to have been employed for thousands of years in the arts in the Nile Valley and is recorded as used by the natives of West Africa for many centuries. A few years ago natives of the West Coast of Africa made iron crosses for money exchange. These crosses contained iron of more value than their equivalent in American coin and were bought up freely for American use.

The iron deposits of **Algeria** and **Tunis** are low phosphorous ores, valuable for European furnaces. They are high grade hematite ores, lenticular in shape, associated with schists and limestone.

1913 Algeria had an output of pig iron amounting to 1,349,-000 tons.

1914 Algeria produced 1,514,099 long tons iron.

1918 Algeria produced 850,000 long tons iron.

1913 Tunis had an output of pig iron amounting to 584,644 tons.

1915 Tunis exported 312,000 tons iron ore, valued at \$800,000.

J. E. Barker, English economist, writing in 1916, says: "The metallic iron resources of Algeria and Tunis amount to 75,000,000 tons. The reserves of the rest of Africa are enormous."

Morocco has iron mines that have long been worked but the output is not equal to other northern African countries. The prospect is good for a much larger development in the immediate future. In 1915 Morocco produced 186,149 metric tons of high grade hematite ore.

Angola has deposits of iron that are promising, but not yet extensively worked.

Togoland is also rich in iron, but little worked.

In **Nigeria** the natives have worked iron for centuries in small amounts.

In the **Congo** iron is the most abundant of all the ores. It is found in large amounts throughout all portions of the State in the form of magnetite and limonite. Iron has also been discovered in the neighborhood of Lake Kivu, and explorers mention it particularly as existing in various forms and often in enormous masses, in Katanga. Ironstone, from which iron is easily extracted, is found on the railway line between Elizabethville and the southern border. Seven hundred tons of iron bars, rails, nails and 450 tons of steel bars, came from the smelters of Belgian Congo during the latter half of 1918.

In **German East Africa** iron has been exploited, but the working of the mines has been set back by the war.

In the **Transvaal** enormous deposits of iron are available. Magnetic quartzites will aggregate many hundreds of millions of tons. Hematite, in which old workings are found, occur extensively in Swaziland. Professor G. H. Stanley, writing in 1917, states that in Natal limonite, hematite and magnetite underlie a considerable extent of the coal measures in beds from 1 to 4 feet thick. An order for 2,000,000 tons to be sent to England was cancelled on the breaking out of the war. In Cape Colony large deposits occur in West Griqualand and Bechuanaland. In 1915, the Transvaal exported 487 tons iron pyrites, valued at \$4,200.

Large deposits exist in various parts of the Union. That found in Natal is poor in quality. There are numerous deposits of various qualities in the Cape Province, a few being of the finest hematite with very small percentage of impurities. Much of the ore contains a high percentage of titanium.

In some cases coal and limestone are to be found in close proximity to the iron ore.

Deposits of both hematite and magnetite iron ores may amount to millions of tons. One official writes that "iron will be more useful to the country than gold." On the Orange River and Transvaal the iron ore has a low percentage of phosphorus and sulphur. Mr. W. F. Leathan on February 1, 1918, writes: "In South Africa there are millions of tons of iron ore equal to the best Spanish ore. A small blast furnace near Maritzburg is the only blast furnace so far as I know in the whole of South Africa for dealing with native ores."

Prof. G. H. Stanley of South African School of Mines, says: "Iron ore, fuel and flux of satisfactory quality exist in the Union as do other raw materials required for manufacture of iron and steel. The present position of the South African steel industry is confined to the production of steel from scrap metal."

The Veereniging Steel and Iron Works employ 250 men who produce bars, fencing standards and light rails, and have an output of 10,000 tons per annum.

A smeltery has recently been established at Pretoria, and the estimated cost of producing a ton of pig iron in 1917 was \$20.

A polytechnic school of engineering is being erected in Capetown.

Northern Africa iron mines will produce much iron **Outlook.** for reconstructing Europe. Africa's percentage of total world production will undoubtedly increase gradually.

MANGANESE

Manganese is a metal generally found associated with the carbonates and silicates of iron. It has also been recognized in the atmosphere of the sun, in sea water and in mineral waters. It precipitates many metals from salt solutions. To be saleable the ore must contain 35 per cent. or more manganese and for ferro-manganese 40 per cent.

Principal sources of supply are Brazil, Russia, Cuba, India and the United States. It is also produced in Central America, Japan and Philippines.

Africa offers good prospects for the discovery of deposits of manganese which may contribute largely to the world's supply. The moist tropical climate favors rapid rock decay

and surface concentration of manganese oxides. New deposits are likely to be uncovered. Tunis has deposits said to contain 4,000,000 tons of manganiferous iron ore. The production of Tunis in 1917 was 5,800 tons.

On the **Gold Coast** there is a manganese deposit operated by a British company at Dagwin. From one of these deposits 28,465 tons, valued at \$52,000, were shipped to England in 1917. This deposit was first discovered in 1914; the ore assays 52 per cent. manganese.

Deposits of manganese occur in **South Africa**—one deposit is said to be able to furnish fifty thousand tons of ore assaying from twenty to fifty per cent. manganese dioxide.

Thirty miles east and west of Capetown are deposits of manganese, one of which is estimated to contain 15,000 tons; 124 tons taken out, 1918.

In **British East Africa** manganese is found in the sandstone near the coast.

Egypt has large deposits of iron manganese ore, but the per centum of managnese is small, being 30 to 40. It is almost free of silica.

A deposit of manganese has been uncovered at Lulua on the **Congo**.

A small amount has been taken out in the Katanga region.

Uses. Manganese goes into the manufacture of ferro-manganese which is employed in the steel industry. Steel

alloy containing manganese is particularly important in the manufacture of armor plate and munitions. Managnese is also in demand by manufacturers of glass, electric dry batteries, paints, pottery, tile and brick, these uses requiring, as a rule, a much higher grade of ore than does the steel industry. Also used as alloy in bronze. Manganese forms several oxides.

The price of high grade ore reached \$1 per unit in **Prices.** 1917; in 1916 it was 45 to 65 cents and before the

war 23 to 30 cents. The average value of manganese ores up to January, 1916, was approximately from \$10 to \$20 per ton, but curtailment of ferro-manganese imports from England led to a rapid rise, and in October, 1917, New York quotation was \$1 per unit for 48-cent grade with the chemical ore at from 5 to 7 cents a pound according to grade.

Manganese is coming into greater demand and the deposits, particularly of West Africa, will likely be actively exploited.

CHROMIUM

Chromium is a member of the natural family of elements containing molybdenum, tungsten and uranium. The element occurs chiefly as chrome-ironstone.

Uses. Chromic ore is used in the manufacture of ferrochrome and steel for high-speed tools, armor plate and projectiles, bichromates of soda and potash, chromic acid, chrome alum and refractory brick. The major consumption of chromium is for use as a refractory lining in furnaces for smelting copper and steel.

The principal supplies of chromium come from New Caledonia and Rhodesia. The chief producing belts in America are the Sierra Nevada and Coast Ranges, in California and Oregon.

World's Production of Chromic Iron Ore in Long Tons, 1914

United States	591
Bosnia and Herzegovina	533
Canada	123
Greece	7,059
India	5,986
Japan	2,108
New Caledonia	82,806
Rhodesia	49,009

In 1918 Rhodesia led the world.

The sources of supply of chromium have changed rapidly. Before 1913 Japan and Russia produced considerable amounts. Of the 1916 imports into the United States, Rhodesia supplied 61,850 tons.

Chromic ore is sold on the basis of 40 per cent. chromic acid and 8 per cent. silica, bringing in 1916 from 30 to 50 cents per unit or \$12 to \$20 per ton. In October, 1917, prices stood at 60 to 75 cents for 40 per cent. ore and over, equal to \$24 and \$30 per ton. The California output was 13 times greater than in 1915. In 1913 the price for chrome was \$11 per ton.

Rhodesia, according to the **Rhodesian Herald**, Aug. 31, 1918, contains the largest deposit of high grade chrome in the world. This deposit, discovered in 1906, has been systematically developed and 2,000,000 tons of exceptionally fine quality of chrome are now exposed. The average per cent. of chrome assayed from the ore is 53. The area of the deposit covers 4,500 acres. Engineers estimate that the ore can be delivered at Beira at less than \$8.50 per ton. Water-falls in the immediate neighborhood supply ample power for working purposes.

The ore is shipped from Lorento Marques and Beira to the United States as ballast in ships which carry agricultural machinery to the African colonies. Most of the last two years' exports from Rhodesia went to the United States. France, in which ferro-chrome industry is important, took a large amount, and a small portion went to Holland and England.

Southern Rhodesia first exported chrome iron in 1906. By 1913 the export was 63,383 tons; in 1914, 48,207 tons; 1915, 60,581 tons, valued at \$800,000; 1916, 88,871 tons; 1917, 72,962 tons, valued at \$1,500,000.

During 1917 Rhodesia supplied half the world's output of chrome. This is likely to increase as other sources of supply are diminishing. The principal deposit is at Selukwe.

Outlook. The remarkable output of chrome in Rhodesia during the war will probably continue, as the world calls for an increased amount of chrome for manufacturing steel and ships returning from Africa need bulky cargo for ballast.

SILVER

Silver is a metallic chemical element of a pure white color with a perfect metallic luster. It is widely diffused in nature, occurring in minute amounts in sea water, in the mineral kingdom as free metal, as an amalgam with mercury and as alloys with gold, platinum, copper and other metals. It is the most malleable and ductile of all metals except gold, harder than gold, but not so hard as copper.

Silver is found in United States, Mexico, Canada, Peru, Chile, Bolivia, Germany, Spain and Australia.

The silver production of the world in 1910 was 221,715,-763 ounces; in 1916, 175,933,000, valued at \$119,727,000 and \$115,763,914, respectively. During 1915 Africa produced 1,-160,000 ounces of silver. The total product is valued less than \$1,000,000. There are no direct silver mines in Africa. It is a by-product of the lead, zinc, gold, copper and cobalt mines.

Where Found. The Transvaal produces the largest amount of silver in Africa; it is found in conjunction with lead and cobalt. During 1913, Transvaal produced 952,521 ounces; 1914, 890,562 ounces; 1915, 965,914 ounces.

In the Congo native silver is found with calcite at Mindouli. Also found on the Mayumbe and along Lualaba. Cop-

per ore of Kambove has an average tenor of 42 grams of silver per ton.

In Algeria and Tunis silver is associated with galena deposits.

Silver has attracted prospectors in German Southwest Africa but has never been mined in payable quantity.

Rhodesia is increasing her output of silver from 142,390 ounces in 1913 to 200,676 ounces in 1916. The value of the export of silver from Southern Rhodesia (1915) was \$926,165, or 4 per cent. of total exports.

The production of silver in Egypt rose from 23,952 ounces (1911) to 237,074 in 1915.

Production in 1918: Congo, 10,520 oz.; Egypt, 800 oz.; Rhodesia, 175,700 oz.; Union of South Africa, 938,146 oz.; Madagascar, 20,000 oz.; Mozambique, 1,200 oz.

Africa produces less than one per cent. of world's Outlook. silver and is not likely to increase that proportion soon. Belgian Congo shows the most growth, but the Transvaal will remain the largest producer. There is a demand for silver coins in British East and West African colonies, in Egypt and regions recently liberated from Turkish rule. Great Britain has minted a new silver currency for West African trade.

ZINC

Zinc, known commercially as spelter, is obtained mainly from blende (natural sulphide) and calamine (natural carbonate). A less important source is silicate. Calamine was formerly the most important ore of zinc but at present blende is the chief source of the metal, usually containing 30 to 35 per cent. zinc, the balance consisting of iron sulphide and other impurities. The complex mixture of lead and zinc carbonates and silicate makes a difficult problem for the metallurgist.

Uses. About 60 per cent. of the zinc consumed is used in the galvanized iron industry; the manufacture of brass about 20 to 25 per cent. Rolled zinc sheets are used for roofing, screens, seives and in photographic processes; rolled zinc plates are used in marine boilers to prevent corrosion; zinc rods for electric batteries. The most important zinc alloys in addition to brass and bronze are the various anti-friction metals and aluminum zinc, used for light castings in the motor industry.

Zinc production fell off during the war though much in demand for making brass.

In the production of zinc the United States is first, supplying 35 per cent.; Germany second, 25 per cent.; Belgium third, 15 per cent. The world production for 1913 was 1,200,000 short tons, of which the United States supplied 350,000 tons; Algeria and Tunis 110,000 tons.

Algeria.—Zinc ores, including blende, are worked in the department of Constantine. Ore has been also mined extensively near the Atlas Mountains. The ore, which consists of carbonates above water-level and zinc blende below it, occurs in veins in Cretaceous marls, schists, and limestones. Both lead and zinc ores occur in the Oued Mozib Mine in the department of Oran. Deposits of zinc ore and galena occur in the districts of Souk-Ahras and Tebessa.

Algeria annually mines about 85,000 tons of zinc, and Tunis 30,000 tons. These deposits are operated by Belgian and French companies. The ore is carbonate and silicate, and the mines are not deep enough to reach the sulphide ores.

In 1913 Algeria produced 82,256 tons of zinc, of which 60,000 tons were calamine and 12,000 blende, to the value of \$2,534,862.

In 1914 Algeria exported zinc to the value of \$1,399,636.

In 1915 Algeria exported 16,796 metric tons zinc, valued at \$810,407.

In 1916 Algeria exported 28,973 metric tons zinc, valued at \$1,398,092.

Tunis.—Zinc ore has been obtained from a number of localities in Tunis north of the Sidi-Ahmet Mountains, where the annual output amounts to about 4,000 tons of ore. Deposits of considerable size occur at Fedj-el-Adoum, about 12 miles southwest of Tebursuk, in the highest part of the Jouaouda Mountains.

At Zaghouan, 35 miles south of Tunis, there are deposits of zinc ore, having an annual output of calcined ore of about 5,000 tons. Zinc ore also occurs at El-Akhouat, about 20 miles southwest of Tebursuk.

Tunis in 1913 produced 27,120 tons, of which 20,000 tons were calamine and 3,000 tons were blende. These mines are operated by French and Belgian companies who pay 5 per cent. royalty of net proceeds to the Government of Tunis.

Other Countries.—Zinc is used in the cyanide process for

extracting gold from the tailings, and will probably be more extensively worked in the Waterberg districts of the Transvaal. In 1915 the Union of South Africa produced 352 tons of zinc. The mineral report of 1917 for South Africa states that the zinc output increased in value \$75,000.

An ancient zinc deposit is situated near the Red Sea, at Gebel Rosas in Egypt and continues to yield a small quantity annually. Egypt produced 3,160 tons in 1913.

In 1915 French Africa exported 2,464 tons of zinc ore to the United States.

Zinc is found at Ituri in the Congo.

A considerable deposit of oxidized zinc ore at Broken Hill in Rhodesia consists of two beds. One body of ore is estimated at 250,000 long tons, averaging 26 per cent. lead and 22½ per cent. zinc. The other deposit of 300,000 tons averages 32 per cent. zinc with very little lead. As high as 54 per cent of zinc metal has been taken from this mine. Zinc smelters are being erected in Rhodesia.

Prices. Zinc reached the maximum price of 25c in 1917, and within a year had fallen to 6c. The current price for July, 1919, is 8c per pound.

Outlook. There is plenty of zinc in Africa which will be worked when other more profitable mineral deposits fail. Until the great War there were no smelters for zinc in Africa. The first was established in Algeria.

LEAD

Lead (**Pb**) is one of the earliest known metals, worked by the Egyptians 3000 B. C. It is the heaviest of the base metals, usually found in company with zinc and often with silver. Metal lead is obtained by reduction of lead compounds.

The world's output of lead is in the vicinity of 1,200,000 metric tons annually.

Lead in payable quantities is taken from all sections of Africa, though in small amounts. It exists in K wilu, Mayumba and Mia in the Lower Congo. In 1918 Belgian Congo exported 35 tons of lead.

In Nigeria the natives have worked lead for centuries.

German East Africa has lead mines but not extensively exploited.

In 1913 German West Africa exported lead to the value of \$86,000.

Algeria exported in 1915, 15,046 metric tons, valued at \$494,659; 1916, 23,731 metric tons, valued at \$801,529.

During 1918, Egypt exported 2,493 tons of lead.

In 1915 Tunis exported lead ore, 34,268,300 pounds, valued at \$512,000.

In Mozambique, the Anglo-Portuguese East African Concession, Ltd., of London, with capital of \$250,000, has obtained rights for exploitation of lead.

The Union of South Africa produced 270 tons in 1917. Galena yielding 80 per cent. pure lead is found near Marico in the Transvaal.

The Broken Hill mine, Rhodesia, in 1908 produced 1,000 tons of lead, which was reduced in 1915 to 28 tons and rose to 10,000 tons in 1918. New smelters installed should increase output to 18,000 tons per annum.

Northern Rhodesia produced 4,100 tons of lead ore in 1917. Large reduction and concentrating plants are operated by the Rhodesian Zinc & Lead Syndicate.

Outlook. Lead is found nearer than Africa to the great commercial centers, and not being a bulky commodity for freight ballast, other mines are more profitably worked. The United States, Spain, Germany, Australasia, are leading sources of lead supply. Africa contributes 3 to 4 per cent. of world's total product.

COAL

Coal is the most essential fuel for developing power for industrial purposes and determines centers of humanity. Where coal deposits exist human population is densest. The science of economics demonstrates that it is cheaper to bring industries to the coal mines than coal to the industries. Hence manufacturers of iron, wool and cotton are often found near coal mines.

The annual world consumption of coal runs into many million tons, the main supply coming from the United States.

According to J. E. Barker (1916), coal resources of Africa are:

Transvaal	36,000,000,000	Tons
Rest of South Africa	20,200,000,000	"
Belgian Congo	990,000,000	"
Rhodesia	569,000,000	"
Nigeria	80,000,000	"
Total	57,839,000,000	Tons

It is estimated that in South Africa there is a reserve of 10,000,000 tons of hard coal. Anthracite coal is not very valuable, owing to the large percentage of ash.

Including the Cape of Good Hope, Natal, the Orange Free State, and the Transvaal, South Africa is estimated to have produced 7,000,000 tons of coal in 1917.

The Transvaal coal mining industry is characterized by two prominent features—the enormous extent of coal bearing ground, and the excessive competition among producers, with a consequent reduction of prices to a level rarely leaving a margin for fair return on capital invested. Extensive coal seams in easy access of the Rand gold field is a conspicuous natural blessing.

1913, The Union of South Africa exported bunker coal valued at \$5,200,000.
1914, The Union of South Africa exported bunker coal valued at \$5,000,000.
1915, The Union of South Africa exported bunker coal valued at \$4,550,000.
1916, The Union of South Africa exported 565,663 short tons of coal, valued at \$1,568,687, and bunker coal valued at \$9,944,000.
1917, The Union of South Africa exported 539,626 short tons coal valued at \$1,569,054.

The value of coal in South Africa is enhanced by its proximity to the Rand Gold mines, for which it supplies power in the absence of local water falls. The reserves of the Union of South Africa are given as 55,200,000,000 tons, according to the South African Year Book of 1919.

The exports of coal from South Africa go to Ceylon, India, and the islands of the Indian Ocean; also to South America, from which cargoes of nitrate of soda are brought back. The ports of shipment are Lorentz Marques and Durban.

Of the **Union of South Africa** the great Karoo system contains coal deposits in a long vein averaging six feet in width. Twenty per cent. of this is A-1 coal.

From the bluff at Durban a loading plant has just been installed, capable of loading steamers at the rate of 600 tons of coal per hour. In 1915 Durban exported coal and coke to the value of \$3,709,397, or 20 per cent.

Prices. The price of bunker coal at Durban rose from 16 shillings in 1915 to 31 shillings in 1918. At the pit's mouth, in the Transvaal, the price of coal was 4s

4½d in 1913, and 4s 9 1/3d in 1917 for one ton of 2,000 pounds.

British East Africa has no coal deposits important enough to be worked, though fragments of coal are found in the bed of the streams around Mt. Elgon in Uganda.

In the **Congo** there are two deposits of coal, with reserves estimated at 1,000,000,000 tons.

The coal fields of Rhodesia are of large extent, the **Rhodesia**. producing colliery—the Wankie—turns out roughly 100,000 tons per annum for use on the railways and mines. It is situated 150 miles north northwest from Bulawayo in the direction of Victoria Falls. The scheme which has been proposed for the utilization of these falls for an electric power generating station for the gold mines may check future expansion of the coal mines. It is considered the boldest engineering project ever conceived; the distance from the mines to the Falls is 600 miles. The undertaking is promoted by the African Concession Syndicate.

In Rhodesia the bituminous coal in the vicinity of Wankie is estimated at 750,000,000 tons.

The coal output from the Wankie Colliery was, in 1915, 409,763 tons; in 1916, 490,582 tons; in 1917, 548,954 tons.

Southern Rhodesia exported:

1914	coal to the value of	\$150,000
1915	" " "	130,000
1916	" " "	175,000
1917	" " "	200,000

An additional plant has lately been installed to meet the increased demands for coal and coke from the copper mines in the Belgian Congo.

The output of coal in Rhodesia:

1914	was	349,459	tons
1915	"	409,763	"
1916	"	491,582	"
1917	"	548,954	"

The average selling price was 8s 6.38d. In 1917, 78,501 tons of **coke** were made from Rhodesian coal and small amounts from other mines. Coke is also manufactured in the Congo.

Coal is to be found in considerable quantities in the Congo, but is not as extensively worked as it might be. Large coal fields have been discovered on the shore of Lake Tanganyika

near the exit of the Lukuga, close to the line of the Grand Lakes Railway.

Bitumen has been discovered in the neighborhood of the Stanleyville-Ponthierville Railway and its exploitation is being carried out.

Much importance is attached to the Udi coal fields **Nigeria**, of Nigeria, which have opened up 80,000,000 tons of lignite. The product is a dirty looking brown coal capable of generating considerable steam power for engines. The potential revenue from these mines is undoubtedly large as soon as adequate transportation is established and modern mining methods installed. Many prospecting licenses have already been granted and the question has risen as to whether the Government should not control all of these coal fields.

Udi coal, which is used for bunkering vessels, could be purchased for \$8.50 per ton at Port Harcourt in the spring of 1918. After extended trials the steam value of Udi coal is reported as being from 75 per cent. to 95 per cent. of best Welch coal. The Udi fields are situated 150 miles inland from the Nigerian coast and are capable of 100,000 tons per annum.

Egypt has no coal of commercial importance. There coal and fuel are large imports.

There is coal in **German East Africa**, but it has not yet been scientifically extracted and so the yield has as yet not been very important.

In **Abyssinia** coal is found near Addis Ababa and used for fuel.

Senegal produces a good deal of coal, which has become an important item of commerce. In 1914 Senegal exported 157,839 tons of coke, valued at about \$1,105,000.

Angola has valuable bituminous coal fields and its shale produces a large percent of oil.

A local chemist distilled shale containing 31 per cent. of crude oil and 56 per cent. of coke oil, which is used for benzine, paraffine, and for illuminating and lubricating.

Between **Algeria** and **Morocco** a large deposit of coal is reported.

Mozambique. The amount of coal available here has not met requirements for some time, causing serious complaints in shipping circles. The probability that many more steamers will desire to take coal in Lor-

enco Marques than previously has helped to bring about a working arrangement.

Large deposits of coal on the Zambesi, 20 miles above Tete, and at another point 220 miles from Port Salisbury, are being worked increasingly. Coal is also found near the Shiré river, and again to the northwest of Lake Nyassa.

In **Madagascar** a deposit of coal similar to that of the Transvaal has been opened up, and the vein measures four or five meters in width. Lignite and peat are abundant in Madagascar, and encouraging indications of petroleum have been uncovered. The **Service des Mines** has discovered a very important deposit of hard coal similar to cannel in the southwestern part of Madagascar.

In the **Cape Verde Islands** are several deposits of coal, the Isle Santo Vicente having four, all belonging to English companies.

The **Canary Islands** furnish a great deal of coal to bunkers, as well as other coal, and considerable amounts of kerosene. In 1913 these Islands exported bunker coal to the value of \$7,300,000 and kerosene to the value of \$182,441; and in 1914, bunker coal to the value of \$5,475,000; and kerosene to the value of \$96,120.

Outlook. Coal is not needed for warmth in the greater part of Africa, but for fuel in operating machinery at the two ends of the continent. South Africa is rapidly developing as a manufacturing center, and has immense coal reserves in the Karoo system. Coal is the dependence for power as oil supply is not reliable. Coal of all grades is found in Africa. Madagascar has much hard coal. The climate is too hot in Nigeria to expect as much development as in South Africa.

MICA

Mica is a constituent of granite, gneiss and mica-schist, and distinguished by its perfect cleavage. It is a silicate of alumina, with potash, magnesia and iron and more rarely, soda. The commercial variety is Muscovite, a potash mica, generally known as white mica.

It is used largely as an insulating material in electrical appliances; other important uses are for glazing windows of stoves and furnaces, and for making lamp chimneys and the diaphragms of phonographs. Ground mica is employed in the

manufacture of certain paints, lubricants, piston packing and roofing.

Mica is a very widely distributed mineral. In **Where Found.** dia, the United States and Canada are, in the order named, the chief sources of the world's supply. German East Africa ranks fourth for flake mica, supplying nearly 5 per cent. of world's output, 1914.

The mica of former German East Africa is a dark green or brown Muscovite, splitting easily into smooth, flat sheets, and very free from foreign matter. It is often transparent in half-inch thickness. The main source of production is the Uluguru mountain region. The deposits, first opened in 1902, are of the open quarry type.

The yield of mica in the Uluguru mountains has increased for many years; in German East Africa the monthly output before the war had reached 8,000 kgs., valued at from 2.69 to 2.89 marks per kilo. One hundred tons were exported annually before the war and the output had reached 1,000 tons.

German East Africa exported in 1911, 216,712 lbs. mica valued at 62,892 marks; in 1912, 339,084 lbs., valued at 1,141,-599 marks.

Flakes of considerable size are found in **British East Africa**. On the western side of Lake Tanganyika in the Congo there are also deposits. Small quantities are found in the Transvaal in the Pietersburg district. The mica "books" sometimes are found as wide as five feet across and a foot thick. They occur in pegmatite dikes.

Black mica is found at Fatenga in **French West Africa**.

Sheet Muscovite is found in the plateau of **Madagascar**. Six tons only were mined in 1913.

Nyassaland produced 119 short tons of mica from 1910 to 1912.

Mica-bearing pegmatites are found in **Rhodesia**, former **German Southwest Africa** and the **Kamerouns**.

Prices of Transvaal mica in London, 1917, were \$1.34 for sheets 2x8 inches; 4x7 and 8x8 inches, \$5.00 per ton.

Outlook. Former German East Africa holds forth the most promising future for mica. Already it ranks third in world production of commercial Muscovite. There is much mica available in Africa, but the supplies of America and India are in the centers of dense population and must be exhausted before Africa is greatly developed.

ASBESTOS

Asbestos is a fibrous variety of serpentine (**crysolite**). It is chiefly valuable on account of its incombustibility and as a non-conductor of heat. It is used by being spun or woven, generally with a small amount of vegetable fibre in order to add to its strength. Of the world's production of asbestos in 1912 88 per cent. came from Canada; 4 per cent. from Russia; 7 per cent. from South Africa. The latter source of supply is steadily rising in proportion.

Uses, and Substitutes. The bulk of asbestos is used for insulating steam-pipes, boilers, and packings for internal combustible engines; also for firemen's uniforms, for fire-proof purposes and as a non-conductor of heat as well as of cold, and also as an acid-proof material. It is woven into theatre curtains, holders and mats for hot flat-irons and for other fire and heat proof fabrics. It is largely used in building paper, in walls, roofs and floors, and as a covering for steam pipes and boilers. It is also used in paints for its protective qualities.

"Mineral-wool", which is made by melting slag and limestone together and then, by means of a steam blast, converting the molten mass to a fine fibrous state, is a substitute for asbestos; but can not be spun into thread. It is used in much the same way and for the same purposes as true asbestos—particularly for fire-proof packing material in walls and floors, and as non-conducting packing around boilers and steam pipes, also extensively used in ice-boxes and refrigerators.

Rhodesian Deposits. The most important African asbestos deposits occur in **Southern Rhodesia**, in the Victoria and Be-
lingwe districts, but good deposits in other dis-
tricts have been found also. Rhodesian asbestos is blue crocidolite of excellent quality and has greatly replaced the Canadian supply in the English markets. Labor is cheap in these mines and the mining conditions generally good. The fibre is often four inches long and is especially adapted for electric welding and spinning.

Rhodesia produced asbestos during five years, as follows:

1913	290 tons, valued at \$ 25,000
1914	487 " " " 43,000
1915	2,010 " " " 160,500
1916	6,157 " " " 495,000
1917	9,562 " " " 949,100

In the **Transvaal** important deposits of asbestos have been

worked since 1906, in the Carolina district. It is of high grade and has brought as much as \$300 per ton in London. Fifty miles north of Lydenburg there is a valuable specimen known as **iron-amphibole**, a silicate rich in iron. It has been well and profitably worked, but road transportation has been a great drawback.

In **Zululand** crysolite asbestos is worked at Middle Drift in the Tugela river, and tremolite asbestos near Pomeroy.

The first **South African** field of asbestos to be worked was in Griqualand West, where blue asbestos is found, a sodium-iron silicate (**crocidolite**). This product has been mined for 20 years. The supply seems inexhaustible and forms the largest known asbestos area. The fiber of this variety is short, rarely exceeding two inches and brings \$125 per ton in London. The very short fiber brings less. Railroads through this district would greatly help the industry.

The Union of South Africa produced asbestos in

1913 to the value of \$ 80,000

1914 " " " " 102,800

and exported in

1915 2,083 tons of asbestos, valued at \$179,000

1916 4,228 " " " " 415,100

1917 6,220 " " " " 436,500

One-third of the product is consumed by the local textile factories.

Prices. The 1916 prices were \$200 to \$300 per ton for blue asbestos; fibers of one-quarter to one-half an inch in length in 1916 brought \$75 per ton, and for fibers one-half to one inch brought \$125, and for over one inch, \$175. The average price per ton in England, before the war was \$120.

Prices range according to the length of the fiber from \$15 to \$900 per ton. In the United States the average price during 1917 was \$300 per ton.

Outlook. The Cape Asbestos Company, formed in 1893, controls the bulk of asbestos production in South Africa. The asbestos is mostly obtained by surface quarrying. A few underground mines have been opened. The mining is done by natives, paid according to the quantity they return. Before the war the product was shipped in 100-pound bags to Hamburg, London and Turin, Italy.

Since the outbreak of the war, greater interest has been shown with regard to the mining of asbestos in South Africa.

Both blue and white asbestos are being obtained in varying quantities and supplies are available for many years.

Previous to the war Germany took most of this asbestos. England and the United States are now taking the output of the old and newly-opened areas. Small shipments are also being made to Japan.

Shipments of asbestos mined in the Lydenburg (Transvaal) district have been made to America to the extent of freight space available. Although reported to be not equal in quality to deposits in some other districts, the Lydenburg fibre is of great length, occasionally reaching 18 inches, and mining conditions are exceptionally favorable, thus ensuring a large output at small working cost.

The Union of South Africa holds the world's record for the number of varieties of asbestos fiber produced, including crocidolite, amosite, chrysotile and tremolite. The best known of these is crocidolite, or "Cape blue," which is a spinning fiber and available in large quantities. Several asbestos factories are in operation in South Africa and the industry is expanding. A supply is assured to meet any expansion in the market for years to come, particularly near Lydenburg in the Transvaal. The Carolina district is said to have a limited reserve.

GRAPHITE

Graphite, also known as plumbago, is a black, opaque mineral of a bright, metallic luster, consisting of the element carbon crystallized. It is one of the softest minerals, greasy, and soils everything it touches. Chemically it is identical with the mineral diamond, and a good conductor of electricity.

Graphite occurs naturally in two forms, crystalline and amorphous. Crystalline or flake graphite occurs in veins. Amorphous graphite is usually found near coal mines or other carbonaceous deposits.

The world consumption of graphite is about 100,000 tons per year.

The Annual Production for 1913

Austria	41,000	Tons
Canada	1,500	"
Ceylon	30,000	"
Italy	12,000	"
Mexico	2,000	"
U. S. A.	4,000	"
Madagascar	8,000	"

Where Found. The richest deposits in the world are at Sonora, Mexico, which supplies the pencil manufacturers of the United States. It is produced in New York, Canada, Austrian Alps, Ceylon, Russia, India and in considerable quantities in Madagascar.

The graphite industry has made remarkable progress in Madagascar during recent years. Nearly 200,000 natives were employed in this industry in 1917. The graphite is found in the form of thin flakes not over an eighth of an inch in diameter. The ore contains about 60 per cent. of graphite and usually occurs with decomposed gneiss and schist. Ore has to be crushed and the graphite floated off in water from heavier impurities. Even the purest forms contain a small percentage of volatile matter and ash.

In 1917 the production in Madagascar exceeded by about 10,000 tons that of any previous year and surpassed the output of Ceylon.

Production (Tons)

1917	35,000 Tons
1916	25,480 "

The destination of Madagascar output is about evenly divided between France and England; 8,000 tons was shipped to United States in 1917, via Marseilles.

Production was commenced in Madagascar on a commercial scale in 1910; by 1913 the output had risen to 8,000 tons. The product is of a very valuable grade; the price in England in 1913 was £23 per ton while that from Ceylon was £27, the latter always bringing highest prices in the market.

There is a small output of graphite in the Transvaal near Zoutpansburg. Also found in Sierre Leone and German East Africa.

Good sized reserves are reported in the Congo and Mozambique, awaiting cheaper transportation facilities.

At the close of 1918 and first of 1919 prices for best Prices. quality at Tananariva averaging 90 per cent. carbon, fell from \$145 to \$97 per ton. New York prices during the year were slightly lower than those for domestic flake. Embargoes and lack of ships have seriously hampered the graphite industry ever since the war started. In November, 1918, flake graphite was offered at 600 francs per ton, f. o. b. Tamatavi.

Uses. Making pencils, dry lubricants, grate polish, paints, crucibles and for foundry facings. Most of the Madagascar graphite is used in crucible manufacture, with a small amount employed as lubricants. Graphite is valued according to its freedom from grit, its carbon content and above all, its grain. The artificial product is largely used for lubricating purposes and for electrodes, but not for crucible making as it is devoid of grain.

Graphite is artificially made by the alteration of carbon at high temperatures by two processes: (1) graphitization of moulded carbons and (2) graphitization of anthracite en masse. The artificial product is said to be fully equal to the natural material in electrical conductivity for use as a lubricant and in making stove polish and lead pencils.

Outlook. Belgian, English and French commercial and industrial companies and factories have been constructed in Madagascar for the treatment of graphite, utilizing both wind and water for motive power. This industry is advancing rapidly and is sure of a great future. The present mines have already realized more than a million tons. The estimated capacity of the mines is 4,000 tons per month. Bonneford, a French geologist, writing in 1918, estimates 2,000,000 tons of merchantable graphite near the surface. Important discoveries of graphite have been located on the high plateaux and on the East Coast of Africa. These have interested various nationalities.

The over-production during the war has been largely absorbed.

PETROLEUM

Within the past few years oil has become the most sought-after mineral commodity. Two thousand years B. C. oil was called "burning water" and worshipped as a miracle by superstitious Babylonians who burned it as fuel in crude lamps. Scientists are not yet wholly agreed as to whether its origin is of organic or inorganic matter—whether it arises from decomposition of animal or vegetable substance.

Oil comes from the ground, a dark, thick, strong-smelling, sticky fluid and is sent to factories to be refined into gasoline, petrol, petroleum, vaseline. It enters into many industrial products such as rubber, paint, cement, resin, dyes, candy. All machinery is dependent upon oil to reduce friction. Oil drives automobiles, furnishes light, heats furnaces, pulls freight trains and moves steamboats.

The world's production of petroleum in 1918 was 514,-724,354 barrels of 42 gallons each.

The United States produces about three-fifths of the total; Mexico, Russia, Roumania, Galicia, Dutch East Indies, most of the remainder. The amount produced in Africa is one-half of one per cent. of total. Soundings for petroleum have been made in many parts of Africa without great promise of success.

Production by Countries. Egypt is the chief producing country of Africa. Two fields near the Red Sea at Hurgadar and Gemsah produced during 1917 over

2,000,000 barrels of petroleum. These fields were opened up in 1911 and have been progressively increasing their output. The petroleum is deficient in oils of low specific gravity which do not distill into kerosene suitable for illumination. The oil is chiefly used in marine engines.

On account of the scarcity of coal during the war, Egypt was using vegetable gas made from cotton stalks and other vegetable matter to operate engines.

Production in Egypt—Barrels of 42 Gallons

1913	94,635
1914	777,638
1915	262,208
1916	411,000
1917	500,000

Fifty thousand barrels of oil per annum come from Algeria. The Algerian deposits have been worked for years. Now the Algerian-Morocco Boring Co. has five drilling rigs for active exploitation.

In Morocco at Oued Mellah are found miocene sands thoroughly oil-saturated which hold out hope for valuable developments in this country.

The use of petroleum is rapidly increasing in the Congo as well as in the other parts of West Africa. All new river craft are of the oil-burning type, on account of the absence of gas and electricity and the high cost of coal. A pipe line for conveying oil has been constructed from the mouth of the Congo river 220 miles inland to Leopoldville.

A large part of the illuminating and fuel oils come from America and pay the customs duty of 12 per cent. ad valorem. Before the war the amount of fuel oil used in Belgian Congo was estimated at 20,000 tons a year, but this amount is likely

to increase to 50,000 tons per year. A large quantity of American oil is shipped to Boma for distribution.

A small yield of mineral oils is taken out of the Congo fields. During the second half of 1918 the Belgian Congo exported 400 tons of petrol, 15 tons benzine and 170 tons of other mineral oils.

Union of South Africa. A report of official investigation for petroleum by E. H. Cunningham Craig, September, 1913, closes as follows: "I am of the opinion that prospecting of the folding belt of the Karoo system for crude petroleum and natural gas is of less importance than the development of shale mining and refining. All the evidence to hand at present leads to the belief that an oil shale industry has good prospects for proving successful, and I would urge that no effort be spared to insure that a fair test of its possibilities be made."

The oil shales of South Africa are considered thin in comparison to the Scotch and not very rich. Up to the present only one small area has been properly examined in the north-western portion of the Utrecht district of Natal. Examination indicates a sufficient tonnage to warrant a plant of 300 tons a day. The yield of ammonia is large.

In Southeastern Transvaal at Kirkvorschfontein and near Dordrecht, oil seepages occur.

Manufacture of Motor Fuel. In South Africa efforts have from time to time been undertaken to produce an alcohol motor fuel as a substitute for gasoline. Many sources of alcohol have been tried, including maize, prickly pear, potatoes and cane-sugar molasses. In the molasses of the Natal sugar plantation, the Union apparently possesses a large source of supply adapted for the purpose of motor fuel and known as natalite.

To encourage the establishment of such an industry, Parliament passed legislation enacting that no excise duty should be levied on Union spirits or on ether manufactured from Union spirits, providing such spirits are used as fuel for internal combustion engines. As a result of this legislation a factory for the distilling of motor fuel has been erected near Durban, costing \$400,000. The distilling plant has a capacity of 3,000 gallons per day.

This locally-produced fuel has recently been placed on the Johannesburg market at a price a little below that of gas-

oline. According to a Cape Town newspaper, a warning has been given that this motor spirit is not suitable for cars having carburetors with a cork float as it apparently contains a denaturing chemical which quickly destroys a shellac casing.

Important wells of naphtha exist over a great part of the west coast of the island of **Madagascar**.

Petroleum is being taken out in **Angola** by a Portuguese-American company which has explored the region thoroughly and finds moderate prospects.

A small quantity is obtained in **Mozambique**.

Outlook. The discovery of important oil fields would mean an economic transformation in Africa, so many are the uses of this fluid as fuel lubricant, illuminant and for industrial purposes. Much effort and many prospecting surveys have been made but as yet no very important discoveries have been announced. Egypt is likely to remain the chief source of African petroleum, though Angola and Algeria hold out promise. Thorough and determined investigation will be made throughout the continent after the war.

PHOSPHATES

Phosphate rock is a sedimentary deposit containing phosphate of lime and occurring as a hard rock between beds of sandstone or shale. Phosphates are used chiefly for fertilizing ingredients; also for matches, for making phosphoric acid and for use in metallurgy.

The world's output of phosphate for 1913 was 6,000,000 tons, one-half of which came from the United States. Tunis ranks second to the United States with Algeria third. The reserves of phosphate rock in Northern Africa have been estimated at 300,000,000 tons.

The subjoined table contains the principal numerical data recently published by the International Institute of Agriculture in Rome.

Production of Natural Phosphates (tons)

	1916	1915	1913
Spain	14,000	9,000	4,000
United States	2,014,000	1,865,000	3,161,000
Dutch Antilles	14,000	29,000	36,000
Algeria	380,000	165,000	461,000
Egypt	125,000	83,000	104,000
Tunis	1,695,000	1,389,000	2,285,000
French Isl'nds in Pacific ..	27,000	72,000	82,000

The principal deposit of phosphate in Tunis is Gafsa fields in the southern part, where the annual output runs over a million and a half tons of 60 to 68 per cent. phosphate. These beds have been worked since 1885. The product goes to Southern Europe.

The deposits in Algeria are at Setif and Tebessa in the eastern region and produce 500,000 tons annually. The rock contains 65 per cent. of lime phosphate.

Egypt has phosphate beds at Port Safalgo near Suez canal, and at Sebara on the Nile. These mines are operated by British and Italian firms who ship the product mostly to Japan.

Fertilizers in South Africa. The growing scarcity of fertilizers has long been evident to the South African agricultural community. Strenuous efforts are being made by those interested to convert the large deposits of iron-alumina phosphates known to exist in South Africa into a form suitable for agricultural use. Inquiries are also being made as to the extent and nature of alleged phosphatic deposits in former German Southwest Africa. Deposits of low grade phosphates are found in Natal near Ladysmith and Byrnetown.

One hundred miles inland from Casablanca in Morocco there is a mountain plateau 40 miles long and 25 miles wide which is a veritable storehouse of phosphate. A railway is to be built to this mountain and a monopoly has been given to the Moroccan government.

At Dielor in Senegal there is a large phosphate bed of 50 per cent. of tricalcium phosphate, but not workable.

Deposits of phosphates occur one hundred miles south of city of Tripoli.

Phosphates and sulphates of lime are found in Angola.

Outlook. Under French development Northern Africa will likely continue as the world's leading producer of phosphates. New railroads are being laid and several million tons for a century may be taken out. The labor situation is rather precarious. The bulk of the miners in the desert regions are wandering tribes of Kabyles, who are uncertain in their movements. Tunis, Algeria and Morocco will produce large quantities of phosphates for the eastern hemisphere.

POTASH

Before the war the great bulk of the world's potash (K_2O) came from Stassfurt in Germany. There are also deposits in Alsace, Spain, Galicia and Chili. Since the outbreak of war considerable has been produced in the United States.

In Abyssinia there are deposits from which the salts are carried on camel back fifty miles to the coast, about 1000 tons per month.

The Italian Company developing these deposits estimate a reserve of 850,000 tons. Output steadily increasing.

New deposits of potash and nitrate have been opened up at Poison Hill in German Southwest Africa since the occupancy by the English.

SALT

Salt is generously diffused through Africa, both in form of brine salt obtained by evaporation and rock salt by quarrying.

Salt is found in natron deposits.

In 1912, salt mines were opened on the French Somali coast, and in 1916, there was exported 8,000 metric tons.

German East Africa yields quantities of sodium, and chlorine salts are found. The Central African Mines Company extracts sea salt at various places along the coast.

Tunis (1913) produced 94,100 tons.

Algeria (1913) produced 26,969 tons.

The output was much reduced by the war.

In Abyssinia salt bars are used for money. The natives exchange gold, rubber, ivory and commodities not essential to life, for the salt bars which caravans bring across the desert from Timbuctu.

The Union of South Africa produced in 1918, 57,984 tons of salt valued at £106,000.

Algeria is said to have reserves of 250,000 tons of salt in its mines.

The Congo has salt near the coast but not in the interior. Lake Tchad, although an inland sea without apparent outlet, has no salt deposits, and the imported salt bars are found throughout the Sahara region.

Salt is one of the principal industries of Mauretania and salt beds exist on the coast also. In French Guinea the yearly salt output is not more than 100 tons. In Dahomey the natives of the littoral villages obtain salt from the lagoon waters.

The salt sold by the Mauretanians comes from Sebkhael Khadera where 4,000 tons a year are produced, and from the

Taraze mines which produce 1,000 tons a year. The former is a deep depression in a vast desert region whose center is marked by a trough about 50 kilometers in extent. This trough dries quickly and the salt may be gathered annually. The sand covering the salt is first removed, then the salt is cut into bars weighing about 25 kilograms. There are several layers of salt. When one portion of the trough or pool is exhausted another is worked; the rains fill the holes again and salt is formed. In two or three years the pits are filled to overflowing again. One hundred and sixty thousand bars are mined annually.

It is estimated that the salt thus mined and exported is worth about 1,000,000 francs yearly.

It is pure white, smooth and sometimes has red streaks. This salt supplies the whole of West Soudan.

Salt is packed in goat skins and sold in the Soudan markets for from 10 to 20 centimes per kilogram.

At Goumbou all trading is carried on with salt. Two-thirds of annual imports, valued 200,000 francs, are for salt, the other third for cattle.

In Mozambique the Zambezi Company operates salt plants in several localities.

At Indugo the salt pits are situated three feet below the level of the river Macuae. The water is conducted at high tide to the beds, when it is slowly evaporated, leaving the salt to be shoveled into sacks.

Forty thousand sacks of 60 pounds each is the estimated output of this Indugo station. Considerable salt is exported to foreign countries.

Madagascar yields much salt, as do the smaller islands of the Indian and Atlantic oceans. In the Cape Verde Islands Sal is the center of salt manufacturing industry.

Salt pans are found and worked in many parts of South African colonies. The largest are in the Cape Province near Uitenhage, where 100,000 bushels have been procured in a year.

Export Figures

Mozambique exported salt:—

1913.....through Chinde to the value of	\$4,375
1913..... " Mozambique to the value of	2,742
1913..... " Beira to the value of	7,836
1914..... " Chinde to the value of	5,203
1915..... "	

1916..... " Chinde 2,271,141 lbs. salt.
 1916..... " Mozambique.... 959,662 " "
 1915.... Algeria exported 1,875 tons valued at \$14,475
 1916.... " " 3,910 " " 30,108
 1915.... Egypt exported salt to the value of \$144,246
 1916.... " " " " " 112,764
 1914, French Somali exported crude salt to the value of
\$20,000.

1915, Katanga exported 5.14 tons of salt.

In the second half of 1918, Belgian Congo exported 10 tons table salt.

SODA

Next to lime, soda is the most common alkali.

Borate and benzoate of soda are used in preserving food.

German East Africa yields great quantities of sodium and there seems to be unlimited supply of carbonate of soda.

Two hundred and fifty miles west of Mombassa in British East Africa, is a lake of soda 16 miles long and four miles wide. Inflowing waters have brought the soda deposit and the glare of the tropical sun has drawn the water from the lake, filled past the saturation point with the soda, till it is crystallized into a solid mass.

Magadi Soda Lake, of about 30 square miles, and 10 feet deep, is just north of the German boundary. The bottom of the lake is covered with carbonate of soda which re-forms as water flows into spaces from which soda has been taken. The total deposit is estimated at 200,000,000 tons. Prior to the war preparations were being made for an annual output of 160,000 tons. This Lake was leased for 99 years in 1911 by an English Company. Drying sheds were erected in 1912.

Considerable soda is found in the hills bordering the Nile, and the Egyptian output of this commodity is an important item in the country's commerce, although it has not been sufficiently worked to give it a leading place.

Pretoria in **Union of South Africa** produced soda (1918) valued at \$47,000.

NATRON

Natron or trona is a hydrous sodium carbonate, crystallizing in the monoclinic system. It occurs in nature only in solution as in Natron or Soda Lakes of Egypt. These lakes are eight in number and located in the Libyan Desert, 60 miles northwest of Cairo. They were the source of soda salts used by the ancient Egyptians in their embalming processes.

Natron is found near the volcanic deposits north of Kilimandjaro, German East Africa.

Abyssinia has natron in small quantities.

Eritrea manufactures bicarbonate of soda from natron sent principally to Australia for canning foods.

Natron is used in glass and soap making.

LIMESTONE

Limestone comprises the carbonates, among the most common of rocks. Limestone varies in hardness from the firmest and most close-grained marble to chalk, and furnishes material for many purposes. It is formed of fossil shells, and is used for building stones, in road-making, broken for railroad ballast, as flux in smelting, for making chemicals, glass, concrete, sulphite pulp and paper.

Lime is produced by burning or calcining limestone in kilns and is used in making soap and candles, in unhairing skins and hides; slaked lime is used as a fertilizer, and for purifying coal gas. One of its most common uses is for mortar, made by mixing air-slacked lime and sand with water to form a paste; as the moisture dries out the mortar "sets" and becomes hard and strong, as was the limestone in the beginning. Hydraulic limestones make a cement that combines chemically with water and does not depend on drying for the "setting." This cement is made from hydraulic lime, marls, chalk, clay, volcanic tufa and slag.

Limestone in its various forms is to be found in many countries of Africa and is exported from a few quarries.

Cretaceous formation of Africa is favorable to limestone.

In Senegal are rich deposits of lime in the shell beds that are in process of rock formation. These beds have been worked for many years and in 1879 the Saint-Louis beds exported 130 hogsheads of lime. This shell material makes good pottery and brought about pottery manufacture which, while it has never become an extensive business, has nevertheless furnished much output for local use and small yearly exports also.

In French West Africa, on the beach of Popenguine, is found a white calcareous rock which makes good limestone and lime. Shell deposits of ages have produced a calcareous soil in all this region.

In Madagascar phosphate of lime is found and promises to develop into a large industry.

In the Union of South Africa a large and increasing amount of cement is being made from limestone.

MARBLE

Marble (*marmor*) is limestone capable of taking polish or being used for sculptural purposes. It differs from common limestone in that it is more or less crystallized by metamorphism.

In German Southwest Africa there are mountains of marble, varied in color and said to be equal to Carrara marble in quality. There are great quantities of white marble suitable for statuary, but as yet comparatively little worked. The colored varieties are being more extensively worked.

In French West Africa a good deal of marble has been discovered, some of which has been worked by the natives for many years. In the Bandiagara district is a valuable quarry of such finely crystallized marble that it is used for small sculpture work, fine carving, and for jewelry.

Algeria produces white and pink marble, also yellow, gray and red onyx.

Tunis and Morocco quarries furnished marble for the Roman Republic.

In Egypt, near the Red Sea, there are many varieties of marble. The Egyptians, the Romans and the modern Arabs have all quarried building stone from northern Africa.

DeLaunay, the distinguished authority on minerals, wrote in 1903, that many beautiful marbles would likely be found in the heart of Africa.

GYPSUM

Gypsum is known as hydrated calcium sulphate, of texture so soft as to be easily scratched. A variety of this rock is partially transparent. The best known form of gypsum is alabaster, a beautiful white species popular in making statuettes and other fine ornamental art works.

Alabaster, named for the Egyptian village Alabastron, was quarried near Memphis as early as the days of the Pharaoh Cheops. The rich cream and amber tone of this stone adds much to the attractiveness of the ancient mosques, tombs and citadels of Egypt.

Heat crumbles gypsum and makes a powder known as plaster of paris, which calcined material can be rendered solid again by the use of water, and is used in plaster casts and other ornamental objects. Wall plaster is made from plaster of paris, mixed with sand and animal or vegetable fiber, and

does not set so rapidly as pure plaster of paris. Powdered gypsum is also used in making paper and baking powder.

Gypsum is found in many parts of Africa but has never been made an extensive article of commerce, although in localities its various forms are being worked, and several fine varieties have been discovered in limestone regions. In the Southwest African Protectorate there are enormous deposits.

TALC

Talc is a soft mineral, whitish, greenish or gray in color, and found in granular or fibrous masses. Talc is used in making bath and laundry tubs, hearthstones and fire-brick, griddles, pencils for tailors and dress-makers, gas tips. Powdered, it is used for foundry facings, lubricating machinery, dressing skins and leather, and in paints and toilet powder. It is also used for "loading" in making paper, and may have been used in adulterating sugar or flour.

Talc is mined in Barberton district in sufficient quantities to supply most of the Union of South Africa. The output in 1917 was 785 tons, valued at \$9,700. Slate pencils, tailors' chalk, blanco, toilet powders, cloth balls for cleaning purposes and billiard chalk are now being manufactured in the Union from the local product. Large quantities of powdered talc are used in motor garages for the inside of tires, for soap and paint manufacture, for dressing of leather and lasting of boots and shoes. Practically the whole of the Union requirements in many of these lines are now being supplied from local sources. With increased shipping facilities a good export trade is likely.

CHALK

Chalk, the softest of the limestone formations, resembles white clay, but is more brittle, and can only be used in a substantial way in powdered form. From chalk is made whiting; whitewash, made by mixing whiting with water and a small amount of glue; putty, mixed with linseed oil; adulterant for white pigments in paint. Prepared chalk is used as a toilet powder and for polishing metals and other materials.

There are great chalk beds on the fringe of the Sahara Desert, which have been partially worked for many years.

OTHER PRECIOUS STONES

Diamonds are not the only precious stones to be found in Africa, though most important in quantity and value.

Rhodesia produces topaz, tourmaline, wolframite and others of less value.

East Africa produces topaz, agate, moonstone, quartz, crystal, garnets and, in lesser amount, rubies and sapphires.

Madagascar is rich in precious stones. Rubies, sapphires, tourmalines, beryls and garnets are found near Manandona river. The beryl is green, rose and white. The garnet is of a brownish red, and the tourmaline is of red and yellow tints. Other precious stones known as pierres de fantaisie are abundant in Madagascar. The opal has been discovered but is not yet quarried to any appreciable extent.

Numerous beds of pegmatites exist containing crystals and nuggets of uraniferous stone. These nodules are rich in uranium and contain up to 25 and 26 per cent. of this ore. Their radio-active power has not yet been determined. They are situated between Antsirabe and Betafo.

In **South Africa** are many semi-precious stones, much used for jewelry and other ornamental purposes. The Cape ruby, or precious garnet, is obtained from diamondiferous deposits and cut in Kimberley. These stones bring about \$1.00 per carat and part of them are clear, beautiful stones. Agate or onyx of fine quality is obtained from the river wash of the Orange and Vaal rivers. This takes a high polish and is in demand for personal and household adornment. Red crystals are found in corundum deposits; the balas ruby is found in the Zibaic Mine in the Carnarvon district; verdite is worked in the Barberton district. The laurel crown on the statue of Victory in London came from this mine.

Emeralds are found in **Egypt**, at Djebel Sabara. Some of these stones are very beautiful and bring a high price. In the **Sinai** peninsula are found turquoise and malachite. **Angola** and **German Southwest Africa** also have malachite.

Onyx, chalcedony and other stones that made up Solomon's temple are found in **Africa**.

Prase, a green variety of chalcedony, is found in Swaziland; tiger eye or cat's eye, is crocidolite asbestos hardened by infiltration of silica and of color ranging from yellow to brown, caused by the oxidation of iron. It takes a fine polish and is used in jewelry.

MINERALS OF MINOR PRODUCTION

Basalt, a dark, heavy, fine-grained, igneous rock, is found in the Canaries.

Bismuth, a lustrous, reddish-white metal, used in preparation of pharmaceutical products and cosmetics, is being taken out in small quantities of 60-70 per cent. ore in Rhodesia.

Corundum is an abrasive of very good quality found in decomposed pegmatites. The price in Europe averages \$100 or more per ton.

The principal countries producing corundum are Canada, United States, Naxos, Transvaal, Madagascar. Since the war the production in the two last named has been considerable, the value in 1916 from the Transvaal being £7,762, though previous amounts had been trifling. In Madagascar 1,532 tons were exported in 1916, as compared with 334 tons in 1915.

Corundum has been discovered in payable quantities on a farm in the Zoutpansberg district of the Union of South Africa. After-the-war conditions will not likely be favorable to development of African corundum.

Titanium, a dark gray metal, is found in numerous beds in Madagascar, where the ore sometimes attains 50 per cent. The mines of Betairy contain amounts visible on the surface, exceeding 100,000 tons.

In Tripoli is found **infusorial earth**, valuable in making explosives. It is known in commerce under the name "Tripoli".

Bitumen is being worked near Stanleyville in Belgian Congo.

Mercury is found in Algeria and Tunis.

ANTIMONY

Antimony, a silver-white, crystalline metal used in chemistry and medicine, is found in Morocco, in the Transvaal, and at Djebel Taya, in Algeria.

Asia is the chief source of antimony, supplying 50 per cent. of the world's output. France is second with nearly 25 per cent., followed by Mexico and Austria-Hungary. Algeria produces 1 per cent. but is capable of much development. There is a small output in Morocco and also in the Transvaal. The Algerian ores are nearly all oxidized, and contain many rare antimony minerals. The number of metric tons of antimony mined in Algeria:

1913	582 Tons
1914	1,100 "
1915	9,022 "
1916	28,473 "

This was smelted at Marseilles.

British South Africa produced 617 tons in 1917, and is increasing her output.

Antimony is also found as a by-product of the gold mines in Southern Rhodesia.

Output in the Transvaal in 1915 was 90 tons; in 1916, 720 tons valued at \$73,400; the ore varied from 40 to 70 per cent. In 1918, only 99 tons.

Deposits are found in Rhodesia but not worked.

Uses.—Chiefly as a hardening in white metal alloys, type, shrapnel bullets, Britannia metal, in dyeing and rubber industries, glass making and enameling iron wares. War munitions have called for increased output of antimony.

Monazite, which enters into the fabrication of welsbach burners, is obtained in small quantities in Mozambique.

Radium, the metal in transition between uranium and lead has been discovered in small quantities in German East Africa and Northern Madagascar. Radium is used for luminous paints and for instruments used in airships; also in therapeutics and particularly in the recently discovered cure for cancer.

Platinum to the amount of 1½ ounces to the ton was taken from the Black Reef in South Africa. Traces have been found in Egypt.

Molybdenum and **vanadium** are taken from the Otavi mining district in former German Southwest Africa.

Tungsten occurs with a number of minerals but the only ones dealt with on a commercial scale are wolfram and scheelite, the former being the most common. Tungsten ores are treated by water concentration and if associated with tin are passed through a magnetic separator. Between 1897 and 1914 the price of tungsten ore varied between 9s. and 51s. a unit, the highest price being recorded in 1907.

Uses.—In the form of tungsten powder (metal) or ferro-tungsten (alloy) it is used in the manufacture of special high-speed tool steels; the best tungsten steel will contain up to 20 per cent. metallic tungsten. It is used also for filaments for electric lamps, in various surgical, dental and other instruments, and in less important uses.

The principal countries producing tungsten are United States, Burma, Australia, Portugal, Argentine, Bolivia and Japan; it has been known in Southern Rhodesia since 1906.

but the mines had not been worked for years until the war with Germany; production in 1917 was about 29 tons, valued at \$25,000.

The prospecting in Rhodesia has nowhere been more than a few feet below the surface. The tungsten reefs vary from 200 yards to about a mile long, situated within a block about 10 square miles near Essev Vale. Also occurs in German Southwest Africa.

Nickel, used chiefly as alloy in nickel-steel, is found in Africa. A promising deposit of nickel from pyrrhotite occurs in norite at Iusigora, Cape Province.

A bed of garnierite containing millions of tons, has been discovered at Valozoro, Madagascar. The content of nickel oxide runs as high as 25 per cent. for part of the bed, but the average is 5 to 6 per cent.

There is a small production of magnesite in the Transvaal, 780 tons in 1918. This mineral is used in making refractory bricks and furnace linings and cement floors; also as a source of magnesium salts. Large deposits in Angola in volcanic districts.

Sulphur is found in various parts of Africa. In South Africa there are several deposits, but the only ones of any value are in the northern part.

Sulphur is obtained in the neighborhood of the volcanic deposits of the Sahara Desert, in the hinterland of Tripoli and Algeria. It is also obtained near Novo Redondo in Angola.

Rhodesia is capable of giving good outputs of sulphur. Water in certain localities is so sulphurous as to make the places where these springs occur more or less famous as health resorts.

In 1915 the Transvaal exported 487 tons of iron pyrites valued at \$4,200.

In Madagascar sulphur is found and gives promise of a large output.

Aluminous laterites have been discovered in Ashanti, Rhodesia, Nigeria, Congo. Bauxite deposits in French Guinea have resulted from alteration of the gneisses and feldspathic rocks.

Cinnabar is reported in Transvaal, Abyssinia and Madagascar. Deposits are being worked in Algeria, from which vermillion is obtained.

VEGETABLE PRODUCTS

Although Africa is one-third desert, agriculture seems destined to become the main economic resource of this vast, almost virgin, continent. Jungles and deserts will be reclaimed at least in part. With transportation facilities extending inland from the coast immense plateaux will be opened up for cultivation of grains.

Africa leads the world in production of palm oil, cocoa, cloves, cassava, kola, gums, esparto. Other large exports are dates and olives from North Africa, peanuts from West Coast, bananas from Central Africa, sisal from East Coast, developed largely through German initiative. Fruits for European and American winter markets are profitably raised in the South.

Vegetables originating in Africa include watermelon, Carob-beans, okra, cucumber, Kaffir corn, sorghum, gum Arabic, oil-palm, coffee, kola, gourds, Guinea pepper, Landolphia rubber, locusts, papyrus, ground nuts, canary grass, cardamons, narcissus, lotus, castor-bean, several pot-herbs.

Missions and experiment stations of various nations are teaching the black natives of their colonies the rudiments of modern agriculture. Negroes seem especially adapted for raising cotton, tobacco and coffee. The two latter are increasing on the uplands of Rhodesia, Abyssinia, Liberia and East Africa. Through efforts of the British Cotton Growers' Association cotton is being introduced in all British colonies. Wild rubber of the Congo basin is being supplanted by plantation rubber.

Cassava, rice, bananas and maize are the food staples among hordes of interior natives, who universally cook with vegetable oils. Preparation of the different oils gives employment to large numbers of native women. Kaffir corn, wheat, barley, durra, promise larger yield. Immense grass lands for pasturage extend over the veldts. Raffia abounds in Madagascar. The fertile Nile valley yields long-staple cotton, sugar cane and onions. Natal has expanding tea plantations. Native woods, such as mahogany, cork, okumé (for cigar boxes), rosewood, yellowwood, wattle and mangrove, are of commercial importance. During the world war France utilized her African colonies as a great kitchen garden to supply the commissary.

VEGETABLE OILS

Extracting oils from vegetable matter is an old industry. For many centuries oleaginous products have formed important articles of trade, and the commerce in them today is world wide. All kinds of vegetable oils are produced on the continent of Africa, particularly the **West Coast**, many from native trees and fruits and others from plants introduced into the different sections. Important among these oils are palm, olive, cocoanut, shea, clove, sesame, mafurra, cotton-seed, peanut and kola.

All kinds of vegetable oils are produced, especially on the **West Coast**.

An estimate of exports of vegetable oils, expressed or unexpressed from all Africa, is as follows:

	Tons
Palm Kernel	200,000
Cotton Seed	175,000
Palm	150,000
Cocoanut	100,000
Peanut	50,000
Sesame	25,000
Kola	20,000
Olive	20,000
Shea Butter	5,000
Mafurra	1,000
Castor	1,000

Palm oil stands first in importance and antiquity. The Elais palm tree (*Elaeis guineanis*), or oil palm, grows 60 to 80 feet in height. At the top of the tree is a beautiful spread of leaves, in the midst of which grow the clusters of fruit, resembling huge bunches of grapes. These clusters contain from 300 to 400 nuts (*amunda*) composed of a fleshy pulp, and the seeds or nuts. From the pulp is obtained a crude oil which takes the consistency of butter, while from the nut is obtained the well-known edible oil of superior quality.

The High Congo District abounds also in elais; they are found in the wooded ravines of the district of Stanley-Pool and the Kwango. It is rarer toward Lake Leopold II and the Lower Kasai.

Returns. The elais has few requirements once planted; it suffices to prune and smoke it once a year to insure regular production. A young plant begins to produce at the end of the fifth year and brings about five francs per year.

Belgian factories use annually more than 7,000 tons of palm oil derived mostly from the English and German colonies. The "African World" of July 13, 1918, says:

The Congo is a land which can be literally said to sweat oil. The natural product is badly handled by the natives. New methods must be introduced, the enormous losses in present production prevented, and concentration, packing and sale regulated. Trade, science and administration must be brought to co-operate in the solution of these problems.

In 1915, Belgian Congo exported 11,023,913 kilos palm nuts. In 1916, 22,391,000 kilos palm nuts; 3,852,000 palm oil. In 1917 30,000,000 kilos palm nuts.

Belgian Congo exported, 1920, palm nuts to the value of 58,988,605 francs (39,457,261 kilos) and palm oil valued at 18,511,341 francs (7,624,111 kilos).

Congo exported in 1906, 1995 tons of palm oil and **Future.** 4,895 tons of palm nuts. Production, properly speaking, is almost entirely in the hands of the natives.

The palm tree is found in a region of north **Senegal**. There are great numbers of oil palms in Casamance. The trees are left to destruction by fire and the elements and no provision is made for their reproduction. The trees are tapped when very young for the wine they produce, and in this way numberless staminate trees are destroyed or spoiled.

Palm oil is extracted from the shell of the nut. This shell contains from 60 to 70 per cent. oil according to Lanesan. This oil is edible. In Europe it is used industrially, principally.

The palm almond was introduced on the French market in 1832.

Palm almonds are used in Senegal for soap-making.

In 1914, Senegal exported 1,501,124 kilos palm nuts, valued at \$120,400. In 1915, palm kernels to the value of \$133,088.

Palm nut oil figures in the total exports from **French Equatorial West Africa** in 1913 with 715 tons; palm nuts were 575,137 kilos, an increase over the preceding year when exports had been only 359,324 kilos valued at 116,785 francs.

The English market absorbed nine-tenths of these exports with a total of 438,138 kilos. Germany follows next with 93,-429 kilos, France with 43,570 kilos.

The greater portion of these exports of palm oil were also shipped to England. The total export in 1913 was 118,644 kilos (with an increase over the preceding year when it was only 49,674 kilos valued at 27,322 fr.).

In 1913, French West Africa exported 69,052,244 pounds palm kernels, valued at \$2,917,817; 31,195,555 pounds palm oil, valued at \$1,852,429. Of these Dahomey furnished 47,-017,163 pounds palm nuts, valued at approximately \$2,050,-000; 17,536,684 pounds palm oil, valued approximately at \$1,950,000. In 1914, Dahomey exported 46,724,433 pounds palm nuts, valued at \$1,600,000; 14,568,666 pounds palm oil, valued at \$719,000. In 1915, Dahomey exported palm kernels to the value of \$1,097,827 (45 per cent.); palm oil to the value of \$933,063 (37 per cent.).

In 1914, Ivory Coast exported 12,433,429 pounds palm nuts, 9,479,569 pounds palm oil.

Ivory Coast exported, 1920, palm kernels to value of 11,-239,900 francs and palm oil, 18,023,377 francs.

In 1915, French Guinea exported palm kernels to the value of \$315,018 (10 per cent.).

The oil palm flourishes in Sierra Leone, from Freetown down the coast as far as San Paul de Loanda. It is the most valuable tree of West Africa and probably the most prolific source of human sustenance in the world.

The exports of palm kernels during the year 1916 show an increase in volume of 5,692 tons and in value of £176,672, practically the whole of which went to the United Kingdom.

In 1916, Sierra Leone exported 45,316 tons palm kernels, valued at \$3,400,000; 557,751 gallons palm oil, valued at \$260,000.

Sierra Leone exported, 1920, palm oil valued at £123,207 (514,204 gals.) and palm kernels valued at £1,401,676 (50,-425 tons).

The Gold Coast, in 1913, exported 9,744 tons palm kernels and 860,155 gallons palm oil. In 1915 4,064 tons palm kernels, and 330,990 gallons palm oil. In 1916 palm kernels to the value of \$429,485.

Five thousand years ago the Egyptians used the "sap of the oil palm" for embalming the bodies of their dead. The

palm oil of commerce today is not the sap of the tree, but that from the rich kernels of the fruit of the tree, or nuts, which in former times were supposed to contain little oil.

In "Nigeria, Its People and Problems," by Morel, we read:

The deltaic region of the Niger is the real home of the oil palm with its numerous and still unclassified varieties, although it extends some distance beyond in proportionately lessening quantities as you push north. No other tree in the world can compare with the oil palm in the manifold benefits it confers upon masses of men. Occurring in tens of millions, reproducing itself so freely that the natives often find it necessary to thin out the youngest trees, it is a source of inexhaustible wealth to the people, to the country, to commerce. . . . The collection, preparation, transport, and sale of its fruits, both oil and kernels for the export trade is the paramount national industry of Southern Nigeria, in which men, women and children play their allotted parts. Beautiful to look upon, hoary with antiquity. . . . the oil palm is put to endless uses by the natives.

During the last twelve years, the planting of more oil palm trees has been receiving attention. Economists prophesy the profitable expansion of the palm oil trade.

England and Germany have led in experimental stations for developing and domesticating the native species of oil palms and for propagating new varieties. Italy has also accomplished something in this line.

The natives climb the tree to the height of 60 or 80 feet, then deal a few vigorous blows with an axe to cut the bunches. The fruit is picked up in wicker baskets. Until it is fully ripe the fruit not only adheres to its stem, but the porcupine thorns make separation difficult. The workers collect the clusters into heaps and cover them with banana leaves, exposing them to the sun from three to six days when the nuts rot away from the stem. The oil from the fibrous pericarp is extracted: (1) by fermentation; (2) by boiling. After steaming or boiling, the fibre is placed in an old canoe or large mortar and pounded with wooden pestles. In either process the oily fibre separates itself from the hard inner stone. Sometimes it is thrown into a large canoe half filled with water. As the oil rises to the surface it is skimmed off, boiled and strained for market.

Besides the oil from the fibre, the inner kernel is also valuable. Palm kernels to the value of £4,000,000 are shipped annually to Europe from Africa.

From 15 up to 120 years the plantations give an almost continuous supply of fruit, every tree bearing twice a year, most abundantly in the rainy season. All the trees do not bear at the same time, so that in many equatorial areas the supply of nuts is never exhausted.

Tapping of palms is prohibited.

Palm oil averages in price twice the value of the palm nuts.

The term palm kernels is applied to the soft, oily seeds contained in these nuts, and not to the nuts themselves. They contain about 40 per cent. of oil.

The relative value in England of palm kernel oil and palm oil is £8 and £24 per ton, respectively.

Up to within recent years, palm kernels were crushed and the oil almost entirely used by the soap trade, but chemistry has now found a process of refining and making palm-kernel oil edible, as it may, perhaps, do some day for palm oil itself, as a base for margarine, for which copra and ground-nut oil were formerly employed.

Vegetable oils are made by crushing with powerful machinery the seeds or vegetable matter to be reduced, leaving behind an oil cake, which is used for cattle; or these oils are extracted by dissolving in chemicals. In various localities the backward natives still crush the seeds by pounding in mortars.

Where Found. The elais palm tree grows spontaneously in the Congo in considerable quantities; its natural habitat is practically limited on the north by the fifth parallel and to the south by the 10th. The whole tropical forest region seems favorable to it; only the altitude stops its growth. It prefers sandy soil and it does better in the woods than in savannahs.

Almost all the palm oil exported now from the Congo is derived from the districts of Banana and Boma. The natives on account of its market value devote themselves regularly to this product.

In 1913 Gambia exported 545 tons palm kernels; in 1915 326 tons, valued at \$26,554, which was .01 per cent. of all exports in this production. In 1916 the export was more than double that of the previous year.

In 1913, **Nigeria** exported 174,718 tons palm kernels; 649 tons palm kernel shells; 5,412 tons oil cake; 77,144 cwt. palm kernel oil; and 1,661,780 cwt. all oils. In 1915, 72,994 tons palm oil; 153,319 tons palm kernels. In 1916, 67,442 tons palm oil, valued at \$7,013,000; 161,439 tons palm kernels valued at \$8,698,000.

Nigeria exported, 1920, palm kernels valued at £5,717,981, and palm oil valued at £4,677,445.

Nigerian Regulations, Nov. 21, 1918. Any tree found infected with bud rot must be trimmed, under penalty of the law.

In 1913, **Angola** exported 3,759 tons palm nuts, 918 tons palm oil. In 1914, 3,989 tons palm nuts, valued at \$246,767; 1,348 tons palm oil, valued at \$104,758.

In 1915, **Mozambique** exported palm nuts to the value of \$454,476.

Kamerun is rich in oil palms, as is also Togoland. In the southern part of Tunis are about 2,138,598 date palms.

Exports in 1911 (Tons)

	Oil	Kernels
Ivory Coast	5,800	5,340
Dahomey	14,400	34,200
Sierra Leone	2,902	42,893
Gold Coast	6,441	13,254
Nigeria	77,180	176,390
Kameroon	3,000	13,500
Togoland	3,050	8,100
Belgian Congo	700	2,500

Total Out-put 1911 (Tons)

Oil	113,652
Kernels	303,112

Uses of the Palm. It furnishes food, clothing, drink, shelter, baskets, cooking utensils, tools, rope, torches, musical instruments, lubricant and cooking oils. It furnishes in exchange 90 per cent. of purchasing power. Americans have invented a portable nut crusher, much facilitating the work.

OLIVE OIL

Asia Minor has the credit of being the original home of the olive (*Olea Europaea*), which is the oldest of known

fruits. The tree is evergreen and very hardy, often reaching great age. Certain trees in France and Italy are believed to be 2,000 years old.

The trees bear fruit every other year and those giving the best oil are from January and February crops.

All Mediterranean countries are rich in olives of many varieties. The average oil output is from 20 per cent. to 50 per cent. of the weight of the fruit. Oil is made from fruit that has ripened on the trees and taken as quickly as possible to the mill. On account of the tendency of the fruit to spoil within a few hours, oil mills are scattered throughout all olive districts.

Tunis leads other African colonies in the manufacture of olive oil.

In 1916 there were 11,750,910 olive trees in Tunis, which produced 8,756,000 gallons of oil. In 1918 about half the customary crop of olives was estimated for Tunis. After Italy, the principal buyers of Tunisian olive oils were: Tripoli, 462,491 kilos; Algeria, 133,944 kilos; and Malta, 125,099 kilos.

As to the oils of olive residuum, their importation was null in 1913 as in 1912, and their exportation about stationary. These oils find their way, for the most part, to France. Holland and Egypt bought appreciable quantities in 1913, 285,-818 kilos and 299,361 kilos.

As was shown in the Chamber of Commerce of Tunis, the production of this oil is increasing and Tunisian manufacturing must, in consequence, count on the competition of foreign countries—that of Italy, particularly. And so it proposed to raise the export duty on this product in the Regency.

The exportation of residuum has, nevertheless, decreased; from 915,300 kilos in 1912, it fell to 724,500 kilos in 1913, in other words decreased by 190,800 kilos, which fact more than explains the 47,399 kilos increase constituting the exportation of oil extracted from this residuum; these residuums yield, in effect, from 7 to 10 per cent. when treated with carbon sulphide.

In 1913, **Morocco** exported olive oil to the value of 76,-099 francs. In 1917, **Egypt** exported 181,434,000 pounds oil cake and oil cake meal, valued at \$2,756,287.

Algeria, Egypt and Morocco export olive oil in fluctuating quantities according to the varying weather conditions.

How Produced—**Cost of Production.**

The olives are first spread out and slightly heated for about twenty-four hours. The process requires much skill and experience, as even slight over-heating will damage the product. The fruit is then ground or crushed to a paste until the oil begins to swim on top. The paste goes into round baskets made of rush or alpha weed, or into sacks of similar materials, or iron hoops covered with crash, and a certain number of the receptacles are piled together and subjected to gentle pressure. This first oil is of the finest quality and is called "Virgin Oil." For the second pressing, more force is employed, the oil thus obtained varying in grades and value. The paste is then saturated with boiling water, and subjected to a third and fourth pressing by hydraulic power, but the resultant oil is used only for industrial purposes, like the manufacture of soaps.

The oil as extracted by pressing contains a considerable percentage of water and some vegetable matter. This may be removed by repeated "settling" and "decanting." This product, skimmed off or "decanted," is known as "unrefined" or crude Olive Oil. If made by one of the old style firms, it goes next to underground cellars or vaults, where it is allowed to settle for about a fortnight. One hundred pounds of olives will yield an average of fifteen to twenty pounds of edible oil, i. e., oil of the first pressings.

As olive oil is very sensitive to foreign odors and flavors, manufacturers are obliged to use the greatest care in handling and storing it. The leading manufacturers stock their finished marketable oils in vaults, with walls of glass tiles to facilitate the most scrupulous cleanliness.

The best test is its color—that of a golden- or straw-yellow tint is best. If it is of greenish hue, it is either an inferior grade or it has not been well refined. When fresh and of good quality, it is of sweetish, nutty flavor.

Italian olive oil is more fruity in flavor than the French, and has a more decided olive taste. There is an increasing demand among the best classes of customers for the finer grades of California olive oil, which in flavor and purity alike have attained the front rank.

Olive oil should not be exposed to extremes of light or temperature. Light will fade its color, heat will make it rancid, and cold will cause it to congeal and separate. Cold does not, however, injure the quality.

Uses of Olive Oil. In the average American household olive oil is used only for salads and salad dressing but it is also excellent for frying—fritters, doughnuts or French fried potatoes—it can be heated to higher temperature than either lard or butter and it has no disagreeable odor or flavor. Nor is it expensive, for one gallon of oil is equivalent to seven and a half pounds of butter for cooking.

North African tribes use this oil for anointing their bodies.

Olive oil is, perhaps, the most popular of tropical vegetable oils, and holds a high place among these oils in commerce.

COCOANUT OIL—COPRA

The cocoanut palm (*Cocos Nucifera*), in the countries where it grows, is looked upon as one of the most useful plants. These trees, found in the coast regions of all tropical countries, grow very high, often to a height of 100 feet. At the top is a crown of twenty or more feathery leaves, each twelve or fifteen feet in length. In the middle of this cluster of leaves grows the fruit, from 80 to 200 nuts, according to the age and health of the tree. These nuts are enclosed in thick fibrous husks. The unripe nut is lined with soft edible albumen-like jelly, within which are one or two pints of clear liquid, a nourishing and refreshing drink. When the albumen or kernel hardens it forms the white substance with which we are all familiar and which we call cocoanut. When the ripe kernels are dried in the sunshine they are called copra and it is copra that is pressed for the oil. Cocoanut oil is liquid at a temperature of 65 degrees F. Below this it becomes solidified and looks like lard.

The bearing period of the cocoanut tree is seventy to eighty years. The first cocoanuts may be expected in about six years after the original planting. The tree comes into full bearing about the twelfth year, and from then on until its life is ended it gives an average annual yield of about fifty nuts. The average yield of copra per acre is about one-third of a ton. It was selling at the beginning of the war for about \$150 a ton in the London market. The cost of operating a plantation of cocoanuts is exceedingly small.

Copra and cocoanut oil are produced in tropical countries around the world. The output is increasing in Africa.

In 1914, this oil was extracted in **Nigeria** from 74,000,-000 pounds of copra and from 250,000,000 pounds in 1918. A pound of dried cocoanut or "copra" is equal to the meat of three average cocoanuts, hence it is important to export cocoanut meat in this form to save tonnage.

German East Africa has millions of cocoanut trees. In 1911 German East Africa exported 11,950,070 pounds of copra, valued at 439,093 marks; and in 1912, 9,351,079 pounds valued at 372,003 m.

Mozambique has 1,500,000 cocoanut trees, which produce more oil kernels and copra than can be consumed locally. In 1915 Mozambique exported copra to the value of \$413,-218. This export trade was formerly chiefly with Germany.

In 1915, the **Congo** exported 11,024 tons cocoanuts; 1916, 27,425 tons; 1917, 35,000 tons.

Cocoanut products are among the chief of **Angola**. In 1898, cocoanuts were exported to the value of 351,500 francs, since which time the trade has increased.

At one time traffic in cocoanut products was important in **Senegal**. Senegal soil and climate favor cocoanut cultivation to such an extent that it could be made a very paying business. The yield of the nuts in this region amounts to over 35 per cent. oil.

African islands are all rich in oil production. In 1915, **Mauritius** exported cocoanut oil to the value of \$29,435, and in 1916, to the value of \$46,000.

The Literary Digest says: "The uses of the cocoanut tree and its fruit are many. To the native of these islands it may be said to provide all the necessities of life—food, shelter and clothing. The timber may be used as logs for bridging streams, and for house-building. The plaited leaves are used for thatching the roofs. They are made into beds to sleep on, into mats for the floor, and they serve as plates to eat from. Beautiful baskets and fans are made of the leaves. The flesh of the nut forms an excellent and nourishing food; it produces oil for cooking, for mixing native puddings, for lighting the house, and anointing the body. The milk forms a palatable and refreshing drink. An industry of no little importance among the natives of the different islands is the manufacture of twine, known as sennet, from the husk of the nuts. This material is used chiefly to tie the timbers together in construction of native houses, no nails being

used in such work. Twine and rope of any size up to towing line are made from the fibre. The 'cabbage,' as the soft central part of the head of the cocoanut-palm is called, can be made into a delicious salad. Some of the natives of the South Seas make what is called cocoanut 'toddy' out of the nuts."

On account of the shortage of fats, the cocoanut and its products are coming into new prominence in the United States. Importation into America of copra grew from 56 million pounds in 1914 to 90 million pounds in 1915, 110 million pounds in 1916, 247 million pounds in 1917, and 550 million pounds is estimated for 1918.

How Produced. "The preparation of the copra for market is very simple. The nuts are allowed to fall naturally, and at intervals of once a month, and sometimes not oftener than once every two months, the nuts are collected into piles upon the ground. Each pile contains about 100 nuts. The laborers then split the nuts open lengthwise with a blow from an ax. The kernels are removed with two or three dexterous cuts of a small knife. This is the copra in its raw state. The ordinary daily task of each laborer is to split and clean six hundred cocoanuts. The kernels are exposed to the sun on shallow layers of trays, and protection is provided from showers and from the heavy dews at night. This occupies from three to six days, depending on the climatic conditions. The establishment of a cocoanut plantation, we are told, is an interesting process. The cost varies according to local conditions. Ordinarily, it will run close to \$100 per acre, including clearing the land of underbrush and keeping it clear. It also includes the cost price of the wild land, which ranges from \$1 to \$5 per acre."

CASTOR OIL

Castor oil is obtained from the seed of a plant (*Ricinus communis*). The seeds are more than half oil.

The castor oil plant has a wide range in latitude, but as an economic plant it is limited by the fact that in the higher latitudes its seeds will not ripen, and the yield of oil is inferior to that obtained in warm climates. Generally, the plant may be said to require similar climatic conditions to maize, but with a greater amount of heat.

The castor-oil plant is perennial. It is injured by hard frosts and prolonged cold. In **North Africa** it thrives wherever the cotton-plant does well. It would do well all along the coast, and in the south in the Sahara district, wherever it is assured of sufficient moisture during the summer growing period.

In **French North Africa**, where the plant grows wild, its cultivation was not seriously undertaken until 1916. It is estimated that the crop for 1917 in **Algiers** amounted to 3,000 tons, and to 5,000 to 10,000 tons in **Morocco**. In **Madagascar** and French West Africa the plant grows freely. Both countries are now beginning to develop plantations.

Aviation has increased the demand for castor oil, as a very viscous lubricant. It is used in the manufacture of soap, leather, cloth and celluloid, for lighting, combustion, medicine, and, in China, for food.

The plant is a native of **Senegal**, but has not prospered there, notwithstanding efforts to cultivate it. Export was 9,405 kilos in 1891; now abandoned.

The plant yields 30 to 35 per cent. of oil.

VEGETABLE OILS—SESAME

Sesame (*Sesamum Indicum*) is a plant originating in Tropical Asia and cultivated from time immemorial for its seeds, which produce an edible oil known in commerce as gingli. China, India, Turkey and Persia are the principal sources of production, but a considerable quantity is exported from Africa. The colonies raising it are **German East Africa**, **Nigeria**, **French Guinea**, **Abyssinia** and **Senegal**. The seed yields under cold pressure 55 per cent. of oil, of a clear yellow color, sometimes aromatic and bitter. The residuum is subjected to hot pressure and yields a small amount of oil for making soaps and candles.

In 1913, French West Africa exported 1,833,436 pounds sesame, valued at \$32,369.

In 1914, Upper Senegal and Niger exported 57,750 pounds sesame, valued at \$1,100.

OTHER OILS

Peanut oil is obtained from the peanut (*Arachis hypogaea*). It is raised extensively in **West Africa**, **India** and **France**.

Peanut oil is used as a substitute for olive oil, for peanut butter and for soap.

Peanuts are the principal export of **Senegal**. In 1914, Upper Senegal and Niger exported 6,480,896 pounds arachides, valued at \$141,400; and 5,006,656 pounds peanuts, valued at \$107,000.

At present ground nuts and sunflower seeds are the only oil seeds produced commercially in **Rhodesia**, but experiments conducted at the Agricultural Experiment Station, Salisbury, Southern Rhodesia, have indicated that all other oil seeds, including linseed, sesame seed, niger seed, and *Mai-d-a sativa* seed (known locally as "Chile oil seed") may be grown successfully.

Morocco exported, 1920, linseed to the value of 24,944,- 227 francs.

Arachide is a small papillonaceous plant which bears two or three times a year. The fruit is contained in an elongated pod which grows under the soil and encloses two or three seeds the size of a hazel nut. It yields from 28 per cent. to 32 per cent. of its weight in an excellent edible oil which serves as a substitute for olive oil. The crop varies from 80 to 100 hectoliters per hectare. In 1905 the Congo state exported 49,684 kilograms of arachides.

Kapok seed, from the Javanese cotton fibre tree, contains about 20 per cent. of oil, similar to cotton-seed oil, and is especially used for food for animals.

According to experiments made at **Cantoi**, Kapok is a hardy plant and has great resistance against droughts. The wood is soft and of little value. Kapok is produced principally at **Giava** and from there exported to **Olanda**.

The Eastern Asiatic Company, a Danish concern interested in the extraction of oils from vegetable matter, has secured a stretch of land 15,000 acres in extent in the Waterberg district of the Transvaal. Cotton, soya beans, linseed, ground nuts, maize and castor oil plants will be grown, while it is intended further to experiment with jute. The entire area will be put under cultivation, and a European expert will direct the principal operations of the concern.

Cotton seed oil is treated under chapter on Cotton.

SHEA NUTS

The shea nut grows on a West African tree (*Bassia parkii*), generally known as the karite tree, which has become almost as valuable as the palm for its oil.

Trees have been known to bear 20,000 nuts. The fresh nut has the size and shape of a walnut, but is covered with a smooth skin resembling that of a Spanish chestnut. Inside this is the soft kernel, yellow when fresh and chocolate colored when dry, containing a large proportion of fatty matter, which, when extracted, is called shea butter. The nuts, divested of the outer pulp covering, are dried in sunshine or by fire and the skin removed. The percentage of butter extracted is 17 per cent. of the kernel; by using machinery it could be made 36 per cent.

One native in one day can collect an average of 100 pounds of shea fruit. It appears best commercially, to buy the shelled nuts from the natives and from them to make the butter for shipment as butter takes up less space. The butter is exported in palm oil casks from Northern Nigeria. The principal exporters are at Lagos, Southern Nigeria, West Africa. The karite tree is easily cultivated and in its production lies the possibility of a great trade. Shea butter is especially popular with the Mohammedans and non-meat eaters generally.

Where Found. Karite trees flourish in Senegal but do not pay as well as they should owing to the crude method used by the natives in making the shea butter. It is stated that in Senegal the shea nuts could be made to give 40 per cent. of butter instead of 11 per cent. as is the general average at present and there could be an easy annual export of 10,000 tons.

In 1915, Nigeria exported 10,085 shea products, valued at \$345,000. In 1916, 3,512 shea products, valued at \$160,000.

Above Zagandé is the "Karite" region, extending throughout Soudan and as far as the Nile.

In 1913, French West Africa exported 1,046,713 pounds of shea nuts, valued at \$27,000. Dahomey exported 373,650 pounds of shea butter, valued at \$15,500. In 1914, Dahomey exported 172,123 pounds of shea butter, valued at \$7,100.

How Produced. Native women gather shea nuts from the trees by knocking them off. They are dried and crushed in mortars, forming a damp flour, which is again dried and crushed. It is then boiled, when butter appears on the surface. The cake remains at the bottom. The butter is then placed in another vessel and kneaded into conical cakes weighing from 4 to 8½ pounds. These are wrapped in n'taba leaves, a specimen of the heliotrope, and sent to market.

Uses. The natives use shea butter for cooking, lighting, making soap, and for massaging. Purified, it is edible alone or suitable for use in making artificial cows' butter. It is also used extensively in chocolate manufacture and in confections generally, as well as for making various kinds of soap. The cake is used for cattle and for fertilizer.

MANIOC, CASSAVA, TAPIOCA

Manioc or Cassava (*Manihot utilissima*) is a large, woody tropical plant whose roots furnish the Cassava-starch and tapioca of commerce. The roots, which may reach eight inches in diameter and four feet in length, grow in clusters often weighing 30 pounds.

The "sweet" tapioca, containing 82 per cent of starch, is preferred; but the "bitter" is equally valuable for sizing, yeast, glazing twine, etc.

Prussic acid is found in the roots; it is easily removed by heat and water.

The plant is indigenous to South America. It is a very important food, the roots being stewed, fried or roasted; the sweet variety in many places takes the place potatoes hold in other localities. Ground into flour, grated, or dried, this root furnishes bread stuff. The tapioca most commonly known to commerce as food comes in the form of yellowish or brownish white flakes. The food most commonly known in civilized countries, made from tapioca, is a delicious pudding. Dextrine and grape sugar are also produced from the root, which are used as substitutes for true sugar and syrups, and are much used in confectionery.

Countries. Tapioca or manioc is cultivated in many countries of Africa where it is a great favorite with natives and whites.

In **Senegal**, manioc is not exported, but is widely used by the natives as food. The dry climate is not well adapted to the cultivation, unless a system of irrigation of pure water can be installed.

In **Congo**, manioc is the chief food of the negroes, who raise both the poisonous and non-poisonous varieties. Manioc was introduced into Belgian Congo by traders from America more than two centuries ago. In Kasai the output is 40 tons per hectare, or enough to feed 40 negroes a year.

In **Rhodesia**, manioc grows well, and considerable attention is being paid to its cultivation. Both the climate and the soil are well suited for its growth. Besides its human uses the roots are fed to stock. For removing the poison for local use, the natives dig manioc tubers, which they bury in a stream or pool for a few days until the poison is washed out.

Starch made from Rhodesian manioc has been pronounced good, and the tapioca prepared for food more than fair, so that cultivation of this product has great promise.

Manioc is one of the most extensively cultivated plants in **Madagascar**; it is very useful for the farmer as it grows in any soil. The output is from 10 to 20 tons per hectare from good soil. The natives cultivate it to sell to fecula works or for their own consumption or for their animals. Its cultivation is increasing, and fecula works are multiplying in the colony. Manioc sells at from 17 to 27 francs per ton. In 1912, 184,220 hectares were planted in manioc.

Madagascar raised 800,700 tons of manioc in 1918.

Exports from Madagascar

Years	Tons	Tons
	Flour	Fecula
1913	611	1,166
1914	685	333
1915	1,255	1,726
1916	3,067	2,585

Outlook. Manioc is grown in all tropical countries. Africa has no special advantage over any other and has not exported any great quantity. New factories for extracting fecula are steadily being erected, and the increasing demand for tapioca should result in a greater output from Africa. The United States' supply comes from South America and the East Indies at present, except a small amount grown in Florida.

BARLEY

Barley (*Hordeum sativum*) is an important genus of the cereal plants belonging chiefly to temperate regions, but its limits extend farther north and south than other cereal grains.

There are four distinct species of barley cultivated for the grain. These are common, or two-rowed barley (*Hordeum distichum*), Bere or Bigg (*Hordeum vulgare*), six-rowed barley (*Hordeum hexastichum*), and fan, spratt, or battledore barley (*Hordeum zeocriton*). Barley is said by some authorities to be the most hardy of all grains. Pliny claimed it as the oldest of grains, and varieties have been found in deposits in Switzerland belonging to the Stone Age. We see it often braided into the hair of Ceres or represented on coins. In Exodus 10:31: "And the flax and the barley was smitten; for the barley was in the ear, and the flax was bolled."

How Produced. Barley is cultivated much as wheat and other grains. When ripe the stalks are cut, after which the grain is removed while the straw is utilized for other purposes. The grain is further separated from the chaff, when it is called "pot-barley". Still further reduced it becomes the barley of domestic use, known as "pearl barley".

Uses. As human food barley for many years was not in great favor generally, except for soup and gruel, but it has come back to popularity. Manufacturers of breakfast foods and fancy biscuits and crackers now use it a great deal. It is also used in medicines, for febrile and inflammatory disorders.

The straw is used in making baskets, matting, chair-seats, rope, paper and for thatching. It is also used for brewing beer, for fodder, mixed with other fodder materials, and as fertilizer.

Barley is a very important world crop, amounting in 1915 to 1,293,916,000 bushels.

Barley is raised in all the northern countries of Africa, where it is one of the chief food grains for man and beast. It is also an important product of many of the islands, notably the **Canaries**. Much of the crop is exported to England for making appetizing beverages.

In 1913, **Morocco** exported barley to the value of \$300,000; in 1915, to the value of \$2,568,791; in 1916, to the value of \$3,464,450—one-fourth of entire exports.

Morocco exported, 1920, barley to the value of 24,192,-485 francs.

In 1913 **Algeria** exported barley to the value of \$4,104,-917; in 1914, to the value of \$2,919,511; in 1915, Algeria produced 36,789 metric tons barley, valued at \$1,420,094; in 1916, 170,589 metric tons, valued at \$6,584,581. In this year Algeria had 3,009,000 acres in barley. In 1918, Algeria had 2,794,000 acres in barley, with a production of 58,422,000 bushels.

Algeria, 1921, had 2,513,943 acres in barley yielding 1,099,300 tons.

In 1916, **Tunis** had 1,247,265 acres in barley, producing 297,000 tons, or 4,914,000 bushels; in 1917, 165,000 tons barley; in 1918, 1,238,000 acres in barley, producing 9,186,000 bushels.

The production of barley in **Tunis** was 243,000 tons for 1921.

In **Tripolitania** barley is the chief food supply and is so extensively used in the country that the exports are negligible.

In **Egypt**, barley in some of the provinces is the chief grain crop.

In 1916, Egypt had 438,830 acres in barley, with a crop of 287,037 metric tons, or 13,161,000 bushels. In 1918, Egypt had 336,000 acres in barley, with a crop of 9,871,000 bushels.

Egypt, 1920, had under cultivation in barley 340,231 acres yielding 227,489 tons.

Barley cultivation is increasing in Abyssinia, where it grows well, and furnishes a chief supply of food.

Barley has not reached the state of cultivation in South African countries that it has in the north, but has been found adaptable to many localities. In 1916 the Union of South Africa had 64,000 acres in barley. In 1918 it had 58,000 acres.

MILLET

Millet (Panicum miliaceum) means thousand, so named for its great fertility. Millet is believed to be a native of Egypt and of Arabia, where it has been cultivated from pre-

historic times. Millet is an annual which grows three or four feet high, and requires rich, friable soil. It is principally cultivated in India, southern Europe and northern Africa.

Some of the principal kinds of millet are German, Polish and Indian millet, European broomcorn millet (*Panicum miliaceum*) and Foxtail millet (*Setaria italica*).

This grain is important in native commerce, exchanged for other commodities and in some localities is a medium of exchange.

Millet of Senegal constitutes the principal foodstuff of the native population.

Much is exported to France. In all the colonies, millet is worth from 5 to 15 centimes per kilogram.

From 1890 to 1899 inclusive, 1,032,448 kilograms, or a yearly average of 103,245 kilograms, were exported.

The average annual production of later years has been 1,594,716 pounds, avoirdupois.

A local dish called dumboy, made principally of millet, constitutes the chief article of diet in parts of West Africa.

In French Equatorial Africa millet has an important place, as the following item from a French report indicates: "Millet is the mainstay of the majority of our subjects. It grows in the most varied soils. It yields a good crop. At the old experimental farm in Baol, the yield was four tons per hectare when the plow was used. One ton suffices for the subsistence of three persons for one year. Millet yields from 40 to 70 per cent. alcohol. Starch is also made from it. For the needs of a local industry, it could be distilled in the producing country. The Bambaras make a kind of millet beer (dolo) with which they intoxicate themselves copiously. Sometimes honey is added to it for the purpose of increasing its alcoholic content."

Millet is raised extensively in the Belgian Congo, chiefly for provender.

Uses. Millet is very nutritious and is largely used in the form of groats. Mixed with wheat flour it makes an excellent bread. When ground, it yields 60 per cent. flour and 40 per cent. alcohol. It is chiefly exported for poultry and caged birds. The chief use of millet in most countries where it is raised is for cattle food, both as grain and fodder.

With ashes from millet stems the negroes make soap; they also make dye from the bark of the stems. From the straw they make hats and mats and use it as thatch.

DURRA

Durra, Guinea corn or Turkish millet (*Sorghum vulgare*) is believed to have originated in India. It grows in all the northern and tropical countries of Africa.

In the Soudan the principal food of the natives is durra, grown in very primitive fashion. The women grind it into a coarse meal which is very nutritious.

The natives of Somaliland raise durra along the rivers.

Nigerian natives formerly raised much durra, but American maize seems to be supplanting the native product.

In addition to being so highly prized by African natives as food, durra is also widely used as cattle food and for poultry.

OATS

Oats (*Avena sativa*) belong to the genus *Aveneæ* of the order of grasses. This family contains about fifty species. The cultivated oat is thought to have originated from *Avena fatua* or "wild-oat," of which several species exist in western Asia and southern Europe, and from which a great variety has been developed, notably the potato-oat, white Tartarian and Scotch oat.

The cultivated oat seems to have appeared first in Central Europe. Pliny alludes to bread made of oats by the ancient Germans. This grain was abundant in Asia Minor in very early times, where it was made into bread and used for feeding horses.

The oat is a hardy grain and grows through a wide range of latitude, but gives greatest results in temperate climates.

The world supply of oats in 1915 was 3,532,470,000 bushels. In Algeria, especially, the cultivation of oats has been an important industry for many years.

In 1913, Algeria exported oats to the value of \$2,307,508; in 1914, to the value of \$2,593,727; in 1915, 58,216 metric tons oats, valued at \$2,447,292. In 1916, Algeria had 536,-

000 acres in oats, which produced 13,140,000 bushels, valued at \$4,789,488. In 1917, 682,000 acres in oats, which produced 16,125,000 bushels. In 1918, 558,000 acres in oats, with a production of 26,564,000 bushels.

Algeria, 1921, had 573,855 acres in oats yielding 170,-650 tons.

Tunis also raises oats rather extensively. In 1916, 164,000 acres were in oats, with a production of 2,067,000 bushels. In 1917, 124,000 acres in oats, with a production of 3,996,000 bushels. In 1918 148,000 acres in oats, with a production of 3,858,000 bushels.

In the southern part of Africa oats thrive.

In 1917, the **Union of South Africa** had 250,000 acres in oats, with a yield of 6,928,000 bushels. In 1918, 257,000 acres.

The chief use is that of feeding horses; and the great **Uses.** demand for this purpose has been so widespread that there were more oats raised than either wheat or corn. A horse is said to consume as much oats in three weeks as a man consumes in a year.

Oat meal, which is not meal, but crushed oats, is made from kiln-dried grain from which the husks have been removed. Porridge made from oat-meal is eaten in all countries. Mixed with Indian corn-meal the porridge is then known as "stirabout". Groats are the whole kernels from which the husk has been removed. Ground into meal or flour oats make very good flat cakes or biscuit, but cannot easily be made into bread because of the difficulty in rupturing the starch grains. Oats contain a higher percentage of albuminoids than any other grain and less of starch. It has more sugar, fats and salts than wheat.

WHEAT

Wheat (*Triticum sativum*) is the most nutritious of the cereals. As a world cereal it ranks next to rice in production; aside from a few regions where rice is almost the exclusive food, wheat takes first rank. It is the chief food of white races in all continents.

The history of wheat goes back to very ancient times and in old records is often referred to as "corn," as all cereals were once designated. The grain now universally known as corn was not then known to countries in the Eastern hemisphere.

Wheat grows best in temperate climates but is successfully raised also in semi-tropical latitudes, especially in the high regions of these countries. The United States is the greatest wheat-producing country. Russia standing next and Hungary third. This cereal is grown in all the temperate countries of Africa and thrives particularly in the plateau regions.

Wheat is "red" or "white," "winter" or "spring," "hard" or "soft." There are many varieties.

Of the world's production of wheat for 1915, given as 3,813,000,000 bushels, the United States and Russia each supplied 19 per cent. The total for all Africa was probably not over 2 per cent. It is grown considerably in the French provinces of Northern Africa and is increasing in the **Union of South Africa**. Egypt was an important wheat producer in ancient times. Egyptian wheat is entirely raised by irrigation from the Nile river.

In Egypt farmers use plows improvised from wooden stumps and drawn by donkeys, camels, bullocks and mules. However, as methods improve crops improve also. The country exports wheat every year. In 1915, Egypt raised 38,667,-666 bushels; in 1916, Egypt had 1,447,163 acres in wheat, with a yield of 36,543,000 bushels; in 1917 the amount of wheat raised was 29,834,000 bushels. The acreage in 1918 was 1,286,000 with a production of 32,555,000 bushels.

Egypt, 1920, had under cultivation in wheat 1,190,200 acres yielding 863,022 tons.

During 1916, **Tunis** had 1,239,734 acres in wheat, with a production of 375,400 tons; in 1918, 1,413,000 acres producing 8,451,000 bushels.

Tunis had 1,334,415 acres in wheat, 1920, yielding 142,-300 tons, which was increased in 1921 to 250,000 tons.

Algeria raises hard wheat, largely used in making macaroni.

For 1913, Algeria exported 1,000,000 pounds of wheat valued at \$6,996,829, and wheat flour to the value of \$1,001,-091; in 1915, 113,423 metric tons wheat, valued at \$6,759,000; 17,690 metric tons wheat flour, valued, at \$1,450,974; 3,882 metric tons crushed wheat, valued at \$337,171; 9,128 metric tons wheat bran, valued at \$229,091.

Algeria, 1921, had 2,904,811 acres in wheat yielding 1,-028,900 tons.

The production of wheat in South Africa during the five years 1909-1913 averaged 5 per cent. of the whole production of the British Empire. During the war a much larger production was forced.

In 1916 the Union of South Africa had 785,000 acres in wheat, which produced 6,477,000 bushels; in 1917 it produced 4,790,000 bushels of wheat, and exported 16,244,024 pounds of flour, valued at \$618,002. In 1918, it had 924,567 acres in wheat, which produced 8,833,000 bushels. The average yield of wheat to the acre is 7½ bushels.

The Union of South Africa, 1918, produced 21,566,000 lbs. of wheat.

How Produced. In former times wheat was ground by hand between round stones. Then came mills, when the grain was ground by water or animal power, the first ones very crude, but continually improved, until today flour mills are among the greatest of modern inventions. Besides flour of different grades of fineness and whiteness, mills crush wheat into coarser materials, producing wheat grits and breakfast foods of even coarser grain. Starch is ground very fine from the white part of the grain. Old-fashioned stone mills are still in operation among the Arabs of Northern Africa.

Uses. The whole grain of wheat is ground into a dark, very nutritious flour, said to have every ingredient, in the right proportion, that the human system needs for nutrition. By removing the dark part of the grain, white flour is made—more popular but less nutritious than whole wheat flour. Starch is made from the white part of wheat, and from the hard varieties, marcaroni and vermacelli, used for many generations by the Italians. The husk of the grain, or bran, is used for feeding stock, and has recently become pop-

ular as food, often mixed with other cereals to add to their nutritive values. Wheat straw furnishes provender for horses and cattle, and is used for thatching huts. It is also plaited into "hat straw", for making hats; the famous Leghorn braids first made in Italy, are made of wheat straw, which is gathered green and bleached in the sunlight.

RYE

Rye (*Secale cereale*) is similar when growing to wheat and barley, but it grows in poorer soil and in colder climates. This grain is next to wheat in nutrition, and flour made from rye is used predominantly in northern Continental Europe. Rye was introduced into Europe from the Island of Crete.

The world crop of rye for 1915 amounted to 1,432,400,000 bushels. Of this amount Europe, including all Russia, produces and consumes 95 per cent. Africa produces but little rye, though it is grown in Morocco, Algeria and South Africa. Rye has been called the grain of poverty, but the indigenous and indigent (not to add indolent) Africans seem to have passed over this poor man's cereal. It is being increased gradually in Southern Africa as a forage crop for domestic animals and for the production of alcohol.

It is used much with wheat, the mixture being known *Uses.* as "blend-corn", and makes an excellent bread. Rye constitutes the chief ingredient of "black-bread", so universally used in Russia. Whiskey and vodka are distilled from this grain. Roasted seeds are a good substitute for coffee. The straw is used for hat-braid, floor mats, thatching, in bricks, and largely as fodder for stock.

MAIZE OR MEALIES

Indian corn or maize (*Zea mais*), is, in some parts of the world, as Southern United States, Mexico, Central America and Egypt, the most important food grain. Corn is not extensively used in Europe, except in parts of Italy; but in Great Britain the grain is increasing in popularity. The last reports of British importation of maize came from English colonies in Africa.

When white men came to the Western continent maize was an important food of the Indians. Soon corn became a very important commodity with the colonists and stood many times as the one food between them and starvation.

There are many varieties of maize, grains of the different varieties varying in size, color, form and composition. Some kinds are rich in oil and others in starch.

Corn yields from 15 to 50 bushels to the acre, according to soil. Growers have experimented much with corn in order to bring it to perfection and to produce certain predominant qualities, as starch or glucose. Sweet or sugar corn, and a distinct variety known as pop-corn, are the only two kinds used exclusively for human food. Their production as compared with the total production of all corn, is relatively small.

How Produced. After the kernels have been shelled from the ripe ear they are spread out to dry thoroughly, as they quickly ferment and sprout if left moist and heaped together. Indians formerly parched corn over a fire. Some of it was eaten as parched grains, but most of it was pounded into meal, sifted, and a quantity stored for winter use, when it constituted the principal food.

The dried grains are now broken by machinery into coarse pieces known as cracked corn or samp; ground finer into hominy and grits; still finer into meal, and yet finer into flour.

For making starch the germs are separated from the grains and then pressed between cloths by heavy machinery in order to extract all the oil.

Uses. The young ear of some varieties of corn is eaten as a vegetable or mixed with other ingredients into foods.

From the dried seeds are made cracked corn, grits, corn-meal, starch, glucose, grape sugar, corn-syrup caramel, corn-oil, oil-cake, bran, used variously for human or animal food and for industrial purposes. The stalk of the plant contains a pith which is used in cellulose, and the remainder of the stalk is used in paper and for fertilizer. The spear-like leaves are used for fodder and paper stock; the bushes are used for mattresses and door-mats, and the cobs are used for fuel and to make "corn-cob pipes". Many varieties of corn are dried for the exclusive use of stock and poultry.

Kaffir corn is a native of South Africa and takes its name from the African tribe known as Kaffirs. It belongs to the same group of plants as broom corn and other non-sacchar-

ine sorghums. It was introduced into America in 1888. Those who have tried the kaffir flour say it makes good bread. Kansas has mills for grinding it.

Comparative Yields

	Bushels	
	Grain	Fodder
Red Kaffir Corn	58.25	6.05
White Kaffir Corn	32.55	5.33
Indian Corn or black hull	45.00	3.07

The maize crop of the world for 1915 was 3,875,927,000 bushels, of which the United States raised 71 per cent.

The whole of civilized Africa produces only about one per cent. of the world's supply of maize.

Egypt is the largest producer in North **Where Produced.** Africa, having nearly 2,000,000 acres under cultivation and producing some 8,500,000 muids. Its acreage equals that of wheat or cotton, except in the low rice and sugar lands of the Delta.

In 1915, Egypt produced 74,318,273 bushels of maize; in 1916, Egypt had 2,098,000 acres in maize and millet; in 1917, Egypt had 1,685,000 acres in corn, which yielded 63,757,000 bushels.

Egypt, 1920, had under cultivation in maize 1,937,869 acres.

In **Algeria** owing to lack of summer rains, maize occupies but a very limited area, and the annual production is only about 125,000 muids. Export in 1915 was 894,768 pounds; in 1916, 730,570 pounds. Production, 1917, was 302,000 bushels from 20,000 acres.

Morocco's export in 1915 was valued at \$145,000; in 1916 at \$723,000.

Maize growing in wild tropical Africa suffers from elephants and wart-hogs. A small export (£30,000) was started in 1912, from Rhodesia. In 1915, England and Australia took 29,668 tons. In 1916, the product of 167,012 acres amounted to 83,175 tons.

In 1914-'15 Europeans cultivated in Northern Rhodesia 16,600 acres of maize, exporting 3,850 tons (\$109,500).

In 1914, **Nigeria** exported maize to the value of \$28,232; in 1916, 2,298,122 pounds, valued at \$24,700.

In **Somali** corn is grown in large amounts and is the principal food of the Indians.

In **French Equatorial Africa** corn is grown in all sections, especially at Lobi.

At **Dahomey**, corn and igname are the principal articles of food of the native. It is toasted in the ear or cooked in a meal. Its cultivation is so well developed that exports for starch making amounted to 7,300 tons in 1906.

In **Senegal** corn is only a product of local consumption.

In 1913, **French West Africa** exported 29,263,285 pounds of maize valued at \$205,018.

In 1915, **Dahomey** exported corn to the value of \$63,149.

In the **Belgian Congo** corn is one of the chief products cultivated by the natives, and has spread to nearly every part of the state. Two, and even three crops of corn is the yearly yield in the Lower Congo.

In 1915, **Belgian Congo** exported 269,896 pounds of corn.

A considerable quantity of maize is raised in the **Kamerun**. In 1904 this colony exported nearly 2,000,000 pounds of maize.

The **Gold Coast** exported in 1917, 1,272 tons of corn.

Throughout South Africa corn is known as mealies, probably a corruption of the Portuguese word "milho" which means grain.

The chief produce of **Angola** (1913) was mealies which is ground into a flour called fuba and is the main food of the natives.

Corn has been established in the southern colonies of Africa to a sufficient extent to supply more than the local needs.

In the **Transvaal** maize is grown on practically every farm. Many farmers grow from 200 to 1,000 acres and several have 6,000 acres in this staple. The Kaffirs cultivate a great deal for their own use, both on native locations and on rented farms. The farms average about 5,000 acres each.

The possible planting season lasts two months. Plenteous rains in a favorable climate and properly cultivated soil make great promises for the future.

Maize in South Africa appears to be less seriously affected by disease than most crops.

Orange Free State is by far the largest producer and exporter of maize of any of the four provinces of the South African Union.

The **Union of South Africa**, 1918, produced 585,490,000 lbs. of maize.

Exports of Maize from South Africa—Bags

1908	664,485
1909	1,537,784
1910	1,760,208
1911	1,018,630
1912	963,882

The response of South Africa in meeting the war demand for maize is indicated as follows: 1913, the **Union of South Africa** exported 11,500 short tons maize; 1914, 110,000 short tons; 1915, 149,000 short tons; 1916, 6,827,296 pounds kaffir corn, valued at \$68,929; 1916, 931,110,700 pounds maize, valued at \$4,269,712, and 13,512,240 pounds of maize meal, valued at \$169,646. In 1917, with 3,150,000 acres in corn and maize, the exports were: 1,059,184 pounds kaffir corn, valued at \$16,138; 524,946,464 pounds maize, valued at \$7,396,409; 105,360,864 pounds maize meal, valued at \$1,982,397.

For 1918 the total harvest was estimated to be not more than 30,000,000 bushels. In 1917 it was 34,999,000 bushels; 2,500,000 bags of surplus maize were purchased in 1918 by the British Government.

Rhodesia exported, 1920, maize to the value of £415,130.

In 1916, **Mozambique** exported through Lorenc Marques, 1,944,773 pounds maize, valued at \$42,460; 23,000 pounds maize flour, valued at \$900, and 1,114,105 pounds kaffir corn, valued at \$54,000; 1914, through Beira, Indian corn to the value of \$232,417. The 1918 crop was estimated at 188,450 bags.

Maize during the 1918 season suffered from adverse weather conditions. It is estimated that under favorable conditions the output would have been 500,000 bags. Another cause also responsible for the short crop, was scarcity of labor. In Mozambique the corn crop often alternates with a crop of peanuts or Cape beans.

E. G. Montgomery in the "Corn Crops" (1913) claims that sorghum is the staple cereal of African natives. In Swaziland natives store maize in the husk in trees hanging from branches.

Corn of all varieties is raised throughout the island of Madagascar, over 100,000 acres being under cultivation.

In the Cape Verde Islands maize has become an important crop, raised chiefly for local use.

Corn is raised in the Canary Islands and has become an important food. The corn production in these islands for 1915 was valued at \$50,000, and that for 1916, at \$111,000.

Maize, corn and sorghum are steadily increasing Outlook. in output and seem likely to continue to increase.

RICE

Rice (*Oryza sativa*) is the principal food of one-third of the people of the world. There are several kinds of cultivated rice, as, common rice, swamp rice, upland rice, glutinous rice, besides a hundred minor varieties, all derived from one species.

The whites have fostered its cultivation in equatorial and semi-tropical Africa. The natives are increasingly inclined to raise, eat and export it, especially on the coast of the Indian Ocean.

How Produced. Formerly rice was grown only in marshes and other naturally wet lands, but for generations the practice of flooding rice farms where the moisture is not sufficient has been common. Modern irrigation has turned many bush lands, waste and hill lands into productive rice fields. When the crop is reaped the laborers work in the mud and water, often above the knees. Upland rice, cultivated during the rainy season and often helped by means of artificial watering, is generally whiter than rice of the marshes.

"Paddy" is the term given to rice before it is decorticated; after hulling it is known as "cargo rice". It is then milled to remove the outer skin, when it becomes "skinned" or "white" rice. By another milling process the grains are polished and the finished product is that of common domestic use.

Uses. Rice is chiefly used in the whole hulled grain as food but it is cooked in many ways, either alone or mixed with other food materials. It is popular made into puddings and other desserts, and a modern process of swelling or "puffing" the grains into dry, light, flakey ovals has made it a popular breakfast food. Rice flour, generally mixed with the flour of other grains, is made into bread and cake. Rice is a very nutritious cereal, although it is not as complete in food elements as several other grains.

The following method of culture is taken from the "Cotton Growers' Annual", 1918:

Preparations for the crop begin in February or March. Planting is done in March and April.

Picking begins in September and is usually finished by December 1. By legislative decree, all cotton plants must be pulled up and removed before December 31st, to prevent the boll worm from hibernating.

Ginning is usually done at ginning factories in the interior towns. The "ginners" are mostly owned by interior cotton merchants, and the large exporting houses.

Yield averages about 450 pounds Lint Cotton per acre.

Staple varies in length, being from 1 to $1\frac{1}{4}$ inches, the latter being the length of the new "Sakel" or "Sakellaridis" variety.

Planters sell to the ginners. Small growers sell to middlemen who sell to the ginners.

Baling and hydraulic pressing is done at the ginnery. The cotton is then rebaled and steam pressed at Alexandria. Bale is 750 lbs. gross.

Among the by-products of cotton the principal one is cotton-seed oil, of which 74,583 metric tons were exported from Egypt in 1914. The residuum after the oil is pressed from the seed is cotton-seed cake, which is a staple food for livestock, especially cattle. The stalks and leaves (which up to 1918 were required to be burned by government order after the crop was harvested in an effort to prevent the spread of the boll weevil pest) were largely used during 1918 for producing vegetable gas. On account of the scarcity of coal, more than 300 engines burning gas made from refuse vegetable matter, were in operation.

Production by Countries. In 1913, **Algeria** exported to France 528,440 pounds of rice, valued at \$23,600. In the ten years, 1904 to 1913, inclusive, **Egyptian** rice cultivation varied from 234,000 to 298,000 acres, about 90 per cent. of which were in Lower Egypt. In 1915 there were 331,000 acres in rice, which yielded 585,000 tons of paddy and 366,000 tons of cleaned rice. Of this

amount 10,422 tons were exported, less than the previous year, when 13,077 tons were exported. In 1916 Egypt had 150,310 acres in rice, with an exportation of 22,473 tons, valued at \$1,406,975. In 1917 the production was 245,000 tons.

In Uganda several upland varieties of rice can be easily grown, especially in the rainy districts bordering Lake Victoria Nyanza. The Department of Agriculture is teaching cultivation, preparation and use of rice, and the clean, hulled grain meets with much better reception than did paddy.

In the East Africa Protectorate, in 1916 there was a small export, but the production does not meet the demand of the population, many of whom are Indians who import rice from India. A ten per cent. import duty is causing more attention to be paid to local cultivation.

In the Congo two kinds of rice are grown, swamp rice in the abundantly watered soil, and mountain rice, which thrives best in light soil with not too much water; the latter was introduced by the Arabs. In 1906 more than a thousand tons of rice were sold in the market of Stanleyville, since which time this grain had grown very much in favor and quantity. By 1915 production had almost overtaken consumption and during that year 2,508,105 pounds were exported. In 1918 the estimated surplus was over 15,000 tons. During the last two years of the war the rice crop was requisitioned by Government.

Rice was introduced into Nyasaland by the Arabs and Portuguese and cultivation has since been encouraged under British rule, partly to supply the native troops, who required about 500 tons per annum, and partly that the natives might be enabled to pay the hut tax. The supply just about equals the local need; a few tons have been exported. The smallest crop of rice in Nyasaland recently was 717 tons in 1914; and the largest 1,817 tons in 1916. In 1915 the exports amounted to 1,606,000 pounds, valued at \$8,030.

In Northern Rhodesia the natives are slowly substituting the red and white rice, introduced by the Arabs, for millet. In the south it is difficult to turn them from mealies, beans and ground-nuts, to rice.

Union of South Africa. Trial crops of rice in Natal have given good results, but rice has not generally been successful in South Africa. As there is a large market for rice in this

part of Africa its cultivation is being encouraged and experiments are being tried in various localities. The annual imports amount to something like \$2,000,000, with a duty of about 25c per 100 pounds.

In Sierra Leone rice areas are limited to the alluvial flats along the banks of rivers and lands that become swampy during the rainy season. These natives care more for rice than most African natives, but they like the large-grained native rice better than the small grained white varieties. The brownish color, however, of the native rice is against its sale in European markets. White American rice has been introduced into Sierra Leone by American missionaries and gives good results.

Exports of home-grown rice from Sierra Leone in 1911, were 340 tons; 1913, 323 tons, valued at \$19,415; 1915, 435 tons.

The Gold Coast imports rice. There are no exports of home-grown rice, and only very small re-exports. There is an import duty on nearly all rice of one shilling per ton.

In Nigeria rice is grown to a small extent and of good quality in the southern provinces, but more extensively in the northern provinces. In the north the reddish native grain is more highly favored than the white imported rice, but there is little trade movement in rice in this country.

Rice is first among foodstuffs in the colonies of French Equatorial Africa. Its nutritive value is much greater than that of millet or igname. It grows in Soudan and Guinea, especially. At Ivory Coast there are few rice fields—in the lagoon regions only. There are still fewer at Dahomey.

At Senegal, though rice grows wild in some places, it is neglected for millet and peanuts. Some is harvested in Cayor. Casamance, 50 years ago exported, whereas today it imports rice; cause, the rubber fever.

In 1914, Senegal imported 108,515,618 pounds of rice, valued at \$2,400,000, and exported 497,184 pounds, valued at \$11,000.

Liberia. During the war it was necessary for the United States to extend a credit of \$5,000,000 for the purpose of purchasing rice and other cereals for Liberia, which the residents had neglected for coffee, leaving them without necessary food materials.

The rice country par excellence is the Niger bend. Inundated periodically by the Bani and the Niger, irrigated naturally by the little falling rivers of the winter season, its fertility is prodigious. By transplanting in the inundated lands as soon as the month of July, two crops a year could easily be obtained.

It is dirty looking, reddish, because it is badly shelled. If it were treated properly it would be as fine as Indo-China rice, and is not so easily attacked by weevils.

Within the last decade **Madagascar** has changed from an importing rice country to one exporting this cereal in considerable quantities. Rice has become a staple crop of this large island, and has spread to every section of it. Both the white and red varieties are cultivated. Plantations are improving with the improvement of methods of cultivation and harvesting. Exports are made to Mauritius, Réunion and South Africa. In 1913, 30 per cent. of the exported rice went to France and over 20 per cent. to British colonies. In 1915 the exports amounted to \$767,857 in value. In 1916 there were exported 30,000 tons, besides supplying the large local demand. Experts claim that exports in Madagascar can easily reach 100,000 tons within two or three years.

Madagascar raised 701,005 tons of rice in 1918.

Rice is cultivated in **Zanzibar** and **Pemba** islands by the natives for their own use.

Mauritius and its neighboring islands cultivate rice in a limited way for local consumption only.

The rice grown in **Mozambique** is of excellent quality and can be made a paying crop. In 1914 Mozambique exported through the port of Lorento Marques rice to the value of \$1,400, and through the port of Mozambique \$5,832 worth. In 1915 the exports through Mozambique were 2,606,755 pounds, and through Quelimane, 1,108,674 pounds.

COTTON

The world cotton production is 20 million 500-pound bales, of which the United States has produced 14 millions in a year (1914), exporting about two-thirds.

The enterprising cupidity of American speculators has become a menace to 1,500,000 European workmen. In spite of the cotton from Egypt and the Indies, English spindles (48,000,000) and looms (650,000) are threatened with idleness.

France needs 180,000 tons more than her colonies produce. This is why the industrial nations seek to extend the cultivation of cotton in their own colonies. After much experimenting, furnishing free seed, instruction and, in some cases, transport, the knowledge has been secured as to where and when not to cultivate cotton.

The French succeed in **Algeria**, **Guadeloupe**, **Madagascar**, **Tahiti**; but especially in **West Africa**. The Niger and Senegal basins furnish an immense well-watered area. Formerly (1865) these coast countries produced cotton, and new activity is now probable.

While the natives have manufactured cloth from wild cotton for many years, only recently has textile machinery of modern design been shipped to South Africa. Cotton mills will likely be established soon on the shore of Lake Nyanza where the cultivation of the cotton plant has proved successful. The war has demonstrated the need of local production of cotton goods, so much in demand throughout Africa, and has awakened the people to the need of factories in various parts of the continent.

Cotton was sowed on 445 acres in **Algeria** during 1921.

Nigeria is the chief field of English exploitation. With an area of suitable soil, one-half that of the cotton states of America, and a population of 18,000,000, in spite of boll weevil and other drawbacks, Nigeria alone can make Lancashire independent of American monopolists.

Pneumatic ginnings are operating near Kano.

Nigeria exported in 1915, 24,061 tons of lint, valued at £56,351; in 1916, 66,555 tons, valued at £243,946. In addition, cotton seed, 1,661 tons in 1915, and 864 tons in 1916, was valued at £5,013 and £2,526.

Nigeria exported, 1920, raw cotton to the value of £716,-733.

The British government bid 2½d per pound for the 1918 crop delivered to the railroad.

The natives have spun and woven cloth for a million people for many years. Scientists, testing samples of cotton, find defects in the Nigeria product, namely, uneven staple, poor seed, and the presence of immature cotton.

Egypt raises a grade of cotton second only to sea island in quality. During the war cotton growing partly gave place to needed cereals. Average reduction amounted to 360,000 feddans. In 1919 acreage was further restricted to 1,400,000 feddans (feddan is 1.1 acre). The crop was 640,000,000 pounds in 1918.

The best variety of Egyptian cotton is known as "Sakellaridis" and has a staple from $1\frac{1}{2}$ to 2 inches in length. Other inferior grades having a yellowish and brownish color are known as Nubari, Abassi, Mit Afifi, Ashmouni, Joamovich. Sakellaridis is used in the manufacture of the finest fabrics, threads, laces, hosiery, corduroy, and has been in much demand for balloon casings, aeroplane wings and automobile tires.

Of the exports for 1917, England took 503,597 bales; United States, 75,865 bales; France, 44,560; Italy, 50,140; Japan, 18,218; Spain, 16,911; Greece, 4,891. The Egyptian crop grows chiefly at the Delta of the Nile, also along its banks in Soudan and Abyssinia.

In South Africa the best success has been in the Rustenburg District of the Transvaal, where the rainfall of 50 to 60 inches makes conditions eminently favorable to cotton. Native labor is cheap and the blacks soon learn how to gather the harvest. In 1917 there was an export of 75,000 pounds. As much could be produced here, says H. H. Fyfe, writing in 1911, as is raised in the whole of the Southern States.

"It costs to grow cotton, about \$10 per acre. Each acre should yield 1,000 pounds of seed cotton and 300 pounds of lint. At 10 cents a pound, which is low, this would fetch \$30, leaving a profit of \$20 per acre. Planting and growing occur during the rainy season, and picking during the dry season."

In Rustenburg, Waterburg, Loutpansburg and Natal, the cotton yield for 1917 was 700,000 pounds of seed cotton and 235,000 pounds of lint cotton. The American upland varieties are best suited to South Africa and are generally of better grade and bring a cent a pound more in Lancashire than similar grades from America.

Union of South Africa, 1920, produced 2,592,200 lbs. of seed cotton.

Nyassaland produced, 1919, cotton to the amount of 4,963,130 lbs.

Such progress as has been made in the development of cotton growing in South Africa is largely due to the British Cotton Growers' Association. While the actual output is yet small and years of sustained effort will be required to make the production an important factor in the world's supply, the difficulties encountered are not so much those of soil, labor, and climate (cotton is a drought resistant) as in adequate means of communication and transportation.

The Zambezi valley offers good prospect of cotton growing because it can be so easily irrigated from the river.

From Uganda 40,000 bales were shipped in 1914. There is a prospect of 400,000 bales per year, better in grade than American middling. The price paid to natives for seed cotton at the gin was 3½ cents per pound, in 1913. During 1912 the best grade of Uganda cotton sold at 18 cents per pound in Liverpool. In this upland region of Abyssinia and Uganda 700 to 800 pounds per acre of cotton along the alluvial valleys is a very favorable record compared to the average of one bale per acre in America. In the Soudan, which has an area of nearly one million square miles, the possibilities of producing cotton are limited chiefly by the scant population, but the acreage is steadily increasing. The best region is between the Blue and White Niles. Mr. E. A. Stanton, an English authority, writes that the future of the Soudan lies in cotton.

During 1912 approximately 60,000 acres were planted to cotton in Uganda. The government distributed 207 tons of seed among the natives. About 1,000 pounds of seed cotton per acre have been grown in good locations. The Agricultural Department maintains an experimental farm where natives are taught how to plow and to ascertain the best variety suited to the region. Through government control, a mixing of varieties has ceased. From the year 1909 to 1913 the production increased seven-fold in quantity and value. Cotton is now the money crop in Uganda. Considerable of the American type known as Allans Sunflower and King, has

been grown and appears better than the same varieties raised in America. The staple averages from 1 to $1\frac{1}{4}$ inches.

The natives of **Mozambique** seem especially adapted to cultivation of cotton. First plantations were started in 1908 and the crop amounted to 3,564,000 pounds in 1917. Egyptian, Sea Island and Upland cottons are being tried out. No cotton mills have yet been erected to utilize the local crop. The plantations lie along the banks of the Zambesi River. The navigable rivers provide good transportation which is lacking in other colonies, but the labor question is unfortunate, as the "boys" of Mozambique find more profitable work as indentured laborers in the Transvaal mines. The Portuguese colony of **Angola** is beginning to export cotton.

From **Northern Rhodesia** 100,000 bales per year seem possible when the railway is extended from Zambesi to Beira. In Northern Rhodesia and Nyassaland the natives are not so advanced as in Nigeria or Uganda which counts against the rapid expansion of the industry.

An increasing amount of cotton is being grown in **Somaliland**. The Italian government has paid (1911) as high as 228 lire per quintal for choice Abassi and Sakellaridis.

In **Algeria** the industry is localized in the Orleansville and Oranie Districts where Egyptian cotton only is raised and yields 1,700 pounds per acre, worth \$260 per acre in 1917. Considerable seed is grown at the Habea experiment station for Algeria, Tunis and Morocco.

In **French West Africa** 20,000 bales were raised in 1916. Cotton growing has not proved so successful on the West Coast under the British experiments on account of excessive moisture. Natives are too lazy to plant cotton every year, when cocoa requires only one planting. Cocoa, peanuts and palm-oil are more profitable crops.

In **British and German East Africa** much money has been spent in developing the cotton industry which seems especially suited for this region. Cotton was the largest item of export from British East Africa, in 1913 amounting in value to \$1,510,642, most of this being from Uganda. Cotton is the third export in importance from former German East Africa. In British East Africa the Abassi variety of the Egyptian cotton gives the best results. Twice a year the Juba River, along

which cotton is raised, overflows and brings down a rich deposit so that it is possible to get two crops a year. With the aid of irrigation, nearly one million acres could be put into cotton. In the upper lake region, both American and middling cotton are successful.

In German East Africa 54,400 acres were under cotton for the year 1913; 4,150,000 pounds of cotton were exported in 1912. The English troops, in 1917, captured 20,000 bales of cotton at the Rufiji Delta. Only 7,000 bales were raised in 1912. The average yield was 160 pounds of ginned cotton per acre. This was of the American Upland variety. Germany appropriated \$50,000 a year to encourage the industry, and the number of colored pupils at the experiment stations was constantly increasing. The chief obstacle with cotton-growing there is the irregularity of rainfall.

Former German East Africa exported, 1920, cotton to the value of £119,255 (1,147,912 lbs.).

Madagascar, Angola, Senegambia and Central Africa have long utilized wild cotton or plants improved by cultivation.

There are many insects that ruin the cotton. One of the most common is a very small insect called oxycarenus which gets into the cotton at the time it is picked and stored. Many experiments have been made to exterminate this insect but so far none have been successful.

A small red bug often kills the plants by eating the roots.

The heliothis is found in the cotton buds, also the boll-worm. Paris Green is used successfully in exterminating the latter. The Gelechia Gossypiella is a green fly that lives on the young plants and keeps them from developing.

North of the Equator, the cotton crop is harvested Harvest. in the fall; south of the Equator the harvest takes place in April or May. The cotton is planted in rows and requires considerable initial cultivation to prevent an over-growth of weeds. The secret of success in cotton growing is to keep the field free from weeds. During the war the shortage of labor resulted in planted areas being so weed-choked that there was a great decrease in the harvest.

Cost of Production. The cost of production varies in different localities, according to soil and labor conditions. Ten to \$50 per acre might be considered a moderate average.

Outlook.

The amount of cotton grown in Africa outside of Egypt, now amounting to about 200,000 bales per annum, is likely to increase ten-fold during the next ten years—if the boll weevil pest is checked. Climatic and labor conditions are favorable to this expansion.

Nigeria has a stretch of 336,000 square miles suitable for cotton which would produce several million bales as labor is plentiful and intelligent.

SISAL

Sisal (*Agave rigida sisalana*), a native of Yucatan, is the most important of African vegetable fibres. It is called the green agave from the bright green leaves. It is a member of the family to which the century plant belongs and other agaves which produce maguey, pulque and mescal. It thrives in different parts of Africa. On the East Coast it is more prosperous than anywhere else in the world. It is driving from export the wild fibres, *Sansevieria ehrenbergii*, of the East Coast, and *Sanserviera Guineensis*, of the West Coast.

According to Commerce Report of June 3, 1917: Three or four years from the date of planting, leaves $3\frac{1}{2}$ to $5\frac{1}{2}$ feet in length are cut with a long curved tool. The cutter is paid 16 cents per day, averaging 1000 leaves. During the cutting period of three years, the operation is repeated 5 or 6 times, producing (average) 120 leaves in **German East Africa**, to 160 in **British East Africa**. However, the former colony is compensated by a fibre value of 3 per cent. to $2\frac{1}{2}$ per cent in the Protectorate.

Bundles of 40 leaves, weighing about $2\frac{1}{2}$ pounds apiece, are railroaded to the factory on light cars, propelled by hand, steam or gasoline. To secure annually from one acre one long ton of dry fibre, requires about 680 plants (17 green leaves making one pound of dry fibre).

How Produced. Sisal planted in the rainy season on barren land will grow. In normal years East Africa produces over 70 per cent. of the world's sisal—20,000 tons from German, 5,000 tons from British and 600 tons from Portuguese East Africa.

Uses. The fibre of the agave is used for making matting, rugs, bags, ropes, harness, hammocks, hats, baskets and brushes.

In 1893 1,000 sisal plants from Florida were imported to German East Africa. These multiplied to 150,000 healthy plants in 1900, warranting the introduction of fibre extracting machinery. The first shipment of clean fibre of $7\frac{1}{2}$ tons, valued at \$755, increased to 18,000 tons, valued at \$1,751,494, in 1912, displacing rubber, which had been the chief product.

Former German East Africa exported, 1920, sisal to value of £364,448.

Stimulated by German success, the English planted at Mombasa in 1902, sisal suckers brought from the German colony, resulting in several plantations which exported in 1914-'15 \$200,000 worth of sisal. The production of sansevieria was abandoned in 1911, being displaced by the cultivated sisal. Samples of clean fibre were tested by the Imperial Institute in London in 1910. The analysis showed that the staple 5 feet long, of very good strength, had: Moisture 11.1 per cent.; ash, 0.98 per cent.; a-hydrolysis, loss, 11.2 per cent.; b-hydrolysis, loss, 14.1 per cent.; acid purification, loss 2.3 per cent, and cellulose, 78.2 per cent.

Acres and Exports. The total acreage in British East Africa devoted to sisal increased from 7,000 in 1912, to 18,000 acres in 1916. Fibre valued \$175,481 (1,681 long tons) was exported during the year ending March 31, 1915. Italy took 2 per cent.; United States 4 per cent. and the United Kingdom 93 per cent. The war decreased later shipments.

The average crop has been three tons per acre; number of leaves per plant, per term, about 160, and amount of fibre $6\frac{1}{2}$ pounds, per 100 leaves. There is no risk from disease with sisal. It is an assured investment easily first in net return per acre. The heavy outlay for machinery requires large acreage for adequate returns. Labor and water must be plentiful.

British East Africa (Kenya) exported, 1920, fibres to the value of £205,710.

Future of the Industry. An association of planters has been formed to foster the industry; in marketing; collection of statistics; improvement of working methods and machinery; recruiting labor and improvement of transportation and rates.

The industry is spreading to **Natal**, which has sold fibre as high as \$400 per ton; to **Rhodesia**, where experiments with various fibres are being made; to **Nyassaland** which exported 233,482 pounds in 1915-1916; to **Mozambique** which exported in 1916, 4,467,249 pounds, mostly through Quilimane, valued at \$145,452.

Maurice hemp, since 1906, is cultivated in the **Lower Congo**. The fibres were valued at \$170 per ton in 1914.

ESPARTO

Esparto (*stipa tenacissima*), or **Alfa**, a tough, wiry, wild grass, thrives best in rocky, arid soil and requires no care except weeding, to attain a height of 20 to 30 inches.

When full grown, in midsummer, it is cut, near the roots, with a sickle, dried in the sun, and tied into foot-thick bundles, which sell for 1 peseta (1918).

It keeps indefinitely. Camels and mules eat it when green. When dried, it is worked into matting, shoes, sandals, fruit-panniers, rope (combined with native hemp) and mainly into paper pulp. This paper is silky and pure and is used in de luxe editions of engravings, as well as for fine cigarette wrappers.

Algeria, **Morocco** and **Tunis** cultivate esparto. The first exports hats, matting and basketry; also the raw material, the value of which was \$1,293,486, in 1914. Much of the crop is woven into mats on hand looms at Crevillente, Spain.

Tripoli exports wild esparto grass to England, as well as manufactured articles, especially baskets. The production of esparto decreases partly by the competition of Norway wood-pulp and also from waste in pulling up of its roots. Irrigation of desert lands would stimulate reproduction.

There are two sorts of alfa in **Algeria**, ***Stipa tenacissima*** and ***Lygeum Spartium***. The former monopolizes the high table land and the so-called "Alfa-See". The govern-

ment controls the amount of crop to be cut. In 1890, 105,000 tons were harvested, worth 7,500,000 francs. Oran has one-half of the cultivated area. The first export from Algeria was in 1862, when this colony furnished half the world's product; Spain, Tunis and Tripoli dividing the rest.

Alfalfa or Lucern (*Medicago sativa*) is a fibre-producing grass, growing luxuriantly on poor soil in northern Africa.

Alfalfa is the chief native herbaceous crop of Tripoli. It is used as fodder, and in the making of paper, matting, cordage, hats, chair-bottoms, etc.

Ramie (*Boehmeria Nivea*) a nettle grass, native of China, is grown in Northern Africa for the manufacture of grass cloth. The fibre is superior to jute, flax or hemp and more expensive.

In 1896 ramie (*Urtica nives*) was imported to the Congo, where it is capable of six harvests per year. Other varieties are less successful. A machine for peeling ramie awaits invention.

Junco or camel grass is used in a cheaper matting.

Bamboo (*Arundinaria dendrocalamus*), a luxuriant growth of tropical or semi-tropical Africa, has many uses. Madagascar produces much of the pulp for paper-making. In Somali the bamboo lines the river banks.

Tambookie or tambuki grass is now used in making a brown wrapping paper of good quality. It brought \$18 per ton (before the war) in London. It is grown in South and East Africa.

The Aloe (*Aloe spicata*) produces a fiber (*pita*) which resembles sisal hemp, with which it is sometimes confused. It is cultivated in Madagascar, Mauritius and other parts of Africa, not for the drug, so much as for material for lace, shawls, scarfs, fancy table covers, as well as rope and twine. A plant may have 40 leaves 8 to 10 feet long, a foot wide, yielding 10 per cent. of fiber.

Flax (*Linum usitatissimum*) is an annual raised in northern and eastern Africa and on the island of St. Helena.

It was the chief fiber product of Egypt from very early times until the close of the 18th century, when cotton took the first place. Belgian Congo and Algeria have increasing acreage.

The Government flax-mill at St. Helena has operated since 1908. Private mills also make thread and cloth, and especially lace. In 1914 St. Helena had a flax tonnage (including seed) of 396,956 pounds.

Before the war, Russia produced 1,000,000,000 pounds of flax fiber annually. All other countries less than 500,000,000 pounds. The Russian fiber is inferior to the Belgian product, which requires very fertile soil and greater care in cultivation to produce Brussels lace. Flax has a slender stem, a yard high, with a blue or white flower at end of each branch. The linen made from the bast of the plant is mentioned in the Old Testament and by Herodotus. Egyptian mummy cloths, under the microscope, are proved to be linen.

How Produced. The various operations through which the crop passes until the flax is ready for the market are (1) pulling, (2) rippling, (3) retting, (4) drying, (5) rolling and (6) scutching.

As soon as the flax is pulled up by the roots, the "bolls" or capsules are removed by the process of rippling or separating the seeds and the stalk, which is done with a kind of comb. Retting or rotting is done either by the water process or the dew process and consists in soaking the stalks in pure water for 10 days or two weeks until the fiber is separated from the core when the stalks are spread over a grassy meadow to dry. Scutching is the process by which the fiber is freed from its woody core and rendered fit for the market and consists of two operations, breaking and then scutching, generally done by scutching mills.

Uses. The linen made from flax is very strong and lasting, which has made it popular through the centuries for clothing, table "linen", bedding, and other household purposes.

The finest flax is of a faint yellowish tint, but for most purposes it is bleached white before used for clothing. However, colored linen is often fashionable, when the cloth is colored in the shades and hues desired.

Jute (*Corchorus olitorius* and *C. capsularis*) came from India. In West Africa it finds an alluvial soil and rainfall suited to its needs. Algeria has a small but growing industry. An experimental plantation in the Lower Congo in 1906

has developed into considerable crops for export. This tenacious, flossy fiber is used in burlap, sacking and cheap wrapping paper, twine, etc. It is mixed with wool or silk, or both, in fabrics.

Hemp (*Cannabis sativa*) was introduced from Arabia and India. It is cultivated in **Belgian Congo, Mauritius and Morocco**, where it is called "Kief" or "Kip". It is the "dakkan" of South Africa. It is used for cloth, cordage, medicine and bird seed. Congo exported 200 tons of hemp goods in the first half of 1918.

Raffia or Raphia (*Pedunculata*) is a native palm of Madagascar, now found throughout the equatorial belt in the marshy valleys, especially in Upper Congo, Lualaba and Kasai.

Raffia fiber is stripped by hand from the foot-stalk of the leaf. Mats of this fiber were used by the German army in packing shells. The natives make mats, basketry and a coarse cloth by mixing raffia with silk. Gardeners and nursery men use raffia as a tying material.

Raffia comes in long, narrow strips $\frac{1}{4}$ to $\frac{3}{4}$ inch in width and from $2\frac{1}{2}$ to 5 feet in length. Its value depends on its color, running from pale yellow to a greenish tint. Dyed strips are now used in teaching children to plait or weave small useful articles. Patients in hospitals recover the use of fingers by such work.

Raffia first appeared in the European markets in 1875, though cheap matting had been an export of Madagascar as early as 1860.

The quantities and values of the exports of raffia fiber from Madagascar in 1913 are shown in the following table:

	M. tons	
France	3,564	£80,636
United Kingdom	331	8,491
Germany	1,824	41,773
Other countries	242	6,148
	<hr/>	<hr/>
	5,961	£137,048

Before the war raffia was quoted in the London market at prices ranging from £25 to £35 per ton.

Madagascar exported raffia fibre to the value of £128,075 during 1918.

Raphia (vine fera) is a species of the numerous Piassava family of palms. It abounds in West Africa. Brazil has the bulk of the industry, but a beginning has been made in Sierra Leone and Gambia. In the former the export value has increased from \$75,238 in 1912 to \$94,500 in 1916 (883 tons). In Gambia a British firm began cultivation in 1915. The big revolving brushes used by night to clean American streets are made from piassava.

Kapok (ereicdendron anfractuosum) is another of the many fiber trees. It is a beautiful ornamental tree which the German colonies were the first to cultivate for industrial uses. It is called false cotton or vegetable silk. Mature in six years, its annual product is three pounds. Its silky fiber makes good stuffing for pillows and mattresses, also for life belts; compressed it can support 36 times its weight in water. It dries quicker than cork. It takes the place of cotton wool in surgery. Invention has made it possible to weave its short fibers. Mixed with bombax cotton it is sold as kapok.

German East Africa exported in 1912 117,004 pounds (\$14,899). **Senegal** in 1914 exported 26,213 pounds of kapok, and nearly as much of other fibers.

Coir (Tamil kayiru) abounds in Mozambique. It is a very tough fiber of the husk of the cocoanut tree. In 1913 the export through Lorento Marques was \$7,272; in 1916, \$3,530.

Chamerops Humilis, a dwarf palm of **Algeria**, is in use as stuffing for furniture and mattresses. **Nigeria** has a palm for cordage making. There is a fiber of promise in the banana (**Musa sapientum**).

Manila (Musa textilis) makes the best rope, also "abaca" cloth, and fine, light yellow paper. Introduced from the Philippines, it is found in several colonies of Africa, especially in Madagascar. . .

Palma, a fan-palm, producing a vegetable hair, a substitute for horse hair, is used for paper and many textile purposes.

Algeria in 1916 exported 24,905 metric tons of vegetable fibers, valued at \$600,809. Considerable comes to America. Baobab (*Adansonia digitata*) is abundant in Lower Senegal, furnishing food, drink, medicine and shelter, as well as clothing and rope. This so-called monkey bread tree, indigenous to Africa, grows 30 feet in diameter. Its use for cordage is reviving.

The Pineapple (*Ananassa sativa*) is not yet profitable for fiber uses.

TOBACCO

Tobacco (*Nicotina Tobacum*) consists of the leaves of several species of this "weed", all prepared as narcotic, for smoking, chewing or inhaling as snuff. Tobacco is the most extensively used of all narcotics. It is a contribution of the American Indian to civilization. Since 1600 its various uses have been learned by the entire world and it is now commonly smoked not only by civilized people, but "even by the savage tribes in the interior of Africa." Thus it has passed from the red American Indian to the black African bushman and the yellow Chinese coolie through the agency of the civilized white man.

One of the chief exports of the United States to every colony of Africa is leaf tobacco and cigars, but conditions in some of the African colonies are quite as favorable for growing tobacco as they are in the United States.

Tobacco may be grown on any agricultural soil and through a wide range of latitude, but the commercial value of the product is more influenced by the soil and climatic conditions than any other agricultural crop.

The leaves of tobacco are rolled, twisted or pressed into hard "plugs" for chewing; cut into fine shreds or particles to be used in pipes; rolled into tight or semi-tight cylindrical forms known as cigars, for smoking. Cigars are made in various ways from various kinds of tobacco, strong, mild, or medium, according to the quality of the leaf and mode of manufacture. The leaves are also dried and powdered into snuff, which was formerly popular taken up the nose. Another use is packing it in woolen clothing or blankets, to keep out moths.

Nicotine, a very poisonous alkaloid, is the active principle of tobacco, and an essential ingredient in the manufacture of certain sheep dips. The high proportion of nicotine in much of the Outshoorn tobacco (due apparently to the large percentage of chlorine and nitrogen in the soil), seems to render the district particularly adapted for experiments in this direction. South African tobacco is especially adapted to the manufacture of this "dip", and can become a valuable commodity for local use and for export.

Algeria uses American machinery and has no laws of restraint or monopoly in production of tobacco. Cultivation began in 1844. Algeria now leads African production. Half the product is made into cigarettes in France, whose government bought, in 1914, \$811,372 worth. In 1917, from 25,254 acres was a yield of 36,155,000 pounds. One-half the crop in 1915 was manufactured near the cataracts. American seeds have been cultivated, with improvement of quality. No exports have yet been made, nor will be until plenty of skilled labor is obtained.

In **Algeria** it is made into cigarettes for home use (35,-000,000 packages) and 66,000,000 were exported, especially to Indo-China. Production has increased from 593 to 1,874 tons, between 1901 and 1916.

Canary Islands' tobacco, under high tariff, does not meet home demands. The annual product, 50,000 to 80,000 pounds (mostly on La Palma), could be greatly increased.

Madagascar in 1916 claimed tobacco as next to hides its chief product.

Transvaal tobacco is unsuitable for cigars, but is held as the best pipe tobacco in the world. It grows best in Pretoria, Potchefstroom, Rustenberg and Zoutpansberg.

Rhodesia exported, in 1915, \$206,980 worth of tobacco, in 1916, \$199,585. Cultivation of cotton instead of tobacco, during the war, reduced the output, but in 1918, the crop was estimated at 500,000 pounds.

Congo has two kinds of tobacco plants, **Nicotiana**, growing to 12 feet, and **rustica**, smaller, but producing a preferred, darker tobacco.

Nyassaland harvested 7,484 acres of tobacco (chief crop) in 1917. Yield per acre is small, 300 to 500 pounds. Export increased from 56,826 pounds in 1905 to 3,308,948 in 1915.

South Africa has large acreage but production of tobacco is less than local demand.

The Union had a yield of 9,000,000 pounds in 1915, 8,000,000 in 1916, nearly 7,000,000 in 1917, and over 8,000,000 in 1918, which was three-fifths of local requirement.

Egypt is largely dependent upon Turkey and Greece and Macedonia for leaf tobacco, from which the famous Egyptian cigarettes are made. This is really the only manufacturing industry of the Protectorate. These cigarettes are largely made by American machinery. In addition to the immense home consumption, the average export of cigarettes from Egypt is valued at \$2,000,000.

Egypt prohibited tobacco growing in 1890, but it has since been revived under government control and assistance. Along the Nile in lower Egypt are experimental tobacco farms, and the manufacture of cigarettes has become one of the principal industries of the country. A large part of the export of these cigarettes formerly went to Germany.

The Italians follow the Turk's state control of the plantations in Tripoli.

Nigeria, in the north, carefully cultivates, but unskillfully cures the tobacco, which is unfit for export.

German East Africa, Somaliland, Uganda and Angola grow tobacco on a "small scale."

Mozambique, Abyssinia and the Islands are greatly increasing their output.

VANILLA AND OTHER ESSENCES

Vanilla (*Vanilla aromatic*a and *V. planifolia*) is native of the tropical forests of Mexico and Central America, where it is cultivated in vast quantities.

In 1819 living plants were taken to Java, and in 1836 to Réunion and then to Mauritius. It adapted itself to the soil of both islands, but was not successfully cultivated until 1850, when the process of pollinating the flowers was learned. Vanilla is now cultivated in nearly all tropical countries where there is plenty of moisture and a temperature that never falls below 65 degrees F. Commercial vanilla is almost wholly produced from cultivated plants.

The product vanilla is obtained from a long, running plant with flexible, succulent stems, which thrive running along the ground, but quickly climb any tree which lends its support. The stem is about as thick as a man's finger and very juicy. The plant bears at from two to four years, when its branches blossom and fruit, which they continue to do for about 10 years. The fruit grows in clusters of three to 12, which look something like diminutive bunches of very slender bananas. When almost mature, nearly four months after the blossoms fall off, they are quickly gathered to prevent opening and spilling of the seeds. If gathered too early the flavor is not good, so great skill is needed in knowing just the proper time. Straggling fruit missed in the picking, is afterward gathered as an inferior harvest. The original crop is sold to the "curers", who take the product in charge to mature it for commercial use.

There are various methods of curing but the object in all is to "sweat" the fruit numerous times by steaming or in sweatboxes, in order to drive out the moisture, and still further sweating is obtained under woolen covers, alternated by exposure to sunshine or drying ovens. When sufficiently dry the pods are tied in bundles for market. They are assorted for packing, the first quality pods being oily, strongly perfumed, black and without defects; after this the pods are assorted according to length and then they are made up into bundles, each packet containing 50; the packets are packed into tin boxes containing 85 pounds of vanilla each. The tins are soldered up and put in wooden cases holding three boxes apiece and are ready for shipment.

How Prepared. In order to obtain the perfume or essence of vanilla one pound of pods is cut up small and put into a gallon of pure alcohol known as 60 over-proof, and shaken daily for four weeks when the spirits may be strained off quite clear and bright. It is then suitable for flavoring or when blended with other scents, makes fragrant perfumery.

Extracts are preparations obtained by evaporation of all material but the concentrated substances of the product extracted. These preparations are usually prepared from powdered dry leaves, flowers or fruit, by exhaustion with solvents (water, alcohol or ether), by percolation.

Another method is to obtain juice from fresh plants by bruising them in a stone mortar with a hard-wood pestle until the mass is reduced to a smooth pulp, which is then expressed in canvas bags.

Vanilla extracts, besides their familiar uses, serve in flavoring tobacco and dyspepsia tonics. The best and largest product is from the islands, Réunion, Mauritius and Madagascar. Seychelles has a poorer quality yet. The export was 66,000 pounds, in 1906, and \$54,000 worth in 1916. The synthetic vanillas and the tonka bean, for adulteration, have reduced production.

Comoro Island produces vanilla at an altitude of 2,500 feet. In 1902 Anjouan gathered 18 tons, from 1,200,000 plants.

Mauritius in 1915 exported to London, vanilla valued at \$9,265.

Réunion's export of vanilla is second in quality and quantity to that of Mexico—165,000 pounds in 1905, and 154,000 in 1909.

Madagascar, including its islands of Nossi-Bé and Comoro exported one-fourth of the world production in 1917—500 tons. In 1916 the price ran from \$1.05 to \$2.00 per pound.

VEGETABLE PERFUMERIES

Essential oils, used in perfumery, are extracted from flowers, fruit, stems and roots, which Africa grows luxuriantly.

Algeria formerly distilled from bigaradier (*Acacia farnesiana*) and rose geranium (*Geraniceae pelargonium*) but the industry faltered during the war.

Neroli, a volatile oil of Algeria, distilled from flowers of the bitter orange, is used both for perfume and flavoring.

Bergamot (*Citrus bergamia rossi*) is a specimen of the citrus family partaking of the properties of both the orange and the lemon. The fruit is lemon color and it has a bitter, acrid taste. It is not known in a wild state and its origin is obscure. Oil of bergamot is obtained from the rind by cold expression and an inferior quality is afterward made from the crushed rinds by the aid of steam.

Tunis exported in 1913, 600,000 pounds of volatile oils and extracts.

South Africa in 1917 exported 9,876 pounds (\$2,400) of dried blossoms.

Madagascar exports dried flowers, especially ylang-ylang, a native of the Philippines.

Zanzibar produces nutmeg oil.

Civet (*veera civetta*) secreted by the civet cat, is exported from Abyssinia and Soudan.

RUBBER

Although rubber has been known for 400 years it has been used only for a century. The early explorers of America found the Indians of Haiti making balls of rubber for games. The first use of rubber in Africa appears to have been for drum-stick heads. In the United States rubber was manufactured for erasing pencil marks, then for boots (Goodyear) for marines, then for coats (Mackintosh) to keep off the rain, then came a multitude of uses in the arts and industries, and finally automobiles appeared to start a remarkable boom.

*Brazil has been the chief source of commercial rubber. There is large production in Central America, Venezuela, Columbia, the Philippines, British Antilles and Dutch Indies. Africa now stands third. African rubber first became prominent in the market in 1885. About 1890 the wild rubber trees of the Congo began to be exploited.

Wild rubber from Africa comes from the funtumia and landolphia, the former a tree, the latter more like a vine which climbs on other trees. Landolphia produces most of the wild rubber. A rubber tree begins to yield latex at the age of six years. Plantation rubber trees are set out 550 to the acre, with cocoa, cotton or coffee trees between the rows.

Only since 1907 has the cultivated crop of rubber been on the market, but now throughout Africa it is rapidly superseding the wild. Of the world's crop of 200,000 tons, one-fourth is the wild product. It is usually of inferior quality, due to neglect in the removal of sticks, dirt, resin, etc.

The latex, or caoutchouc, is obtained in different ways. Sometimes pieces of trees or vines are macerated. Ordinarily incisions in the trunk permit the ooze to fill the attached

*At present the leading source of plantation rubber is the Malay Peninsula and East Indies.

cups. Clots are sometimes formed by allowing the trickle to coagulate on the trunk. Sprinkling or brushing the incision with acid (lemon, sorrel or salt), quickly forms a lump, which is ready at once for packing for shipment. Rubber is obtained by a physical process of pounding and separating the latex; and a chemical process of coagulation by the use of alum, salt, sulphuric acid, citric and acetic juices.

The following is an analysis made at the Imperial Institute of a fair sample of rubber produced by Landolphia Kirkii in the Mozambique Company's Territories, East Africa, i. e., moisture, 5 per cent. caoutchouc, 85. 6 per cent.; resin, 5.5 per cent.; proteids, 1.3 per cent.; insoluble, 2.7 per cent.; ash, .46 per cent.

Protective laws have been made in most districts forbidding cutting down of plants, over-tapping or cutting out of season. Bush fires, locusts, tornadoes and droughts are common. The laws in the great forests are not easily executed. Schools to educate the natives in economical methods of harvesting rubber are popular. The careful inspection by the customs service prevents export of impure (10 per cent.) and over-moist (15 per cent. water) rubber.

In the Congo the law requires replacement by 150 new plants to every ton of rubber produced.

The natives have destroyed almost entirely the wild rubber trees in Madagascar, Mozambique, Zanzibar, and there is a shrinkage in the production of wild trees, indicating that the zenith has been reached, and that wild rubber is on the decline.

British East Africa has several rubber plantations. Ceara (which flourishes on poor, dry soil) and the Para plants are most successful.

Nyassaland and **German East Africa** cultivate Ceara. The first exported in 1915-'16, 46,002 pounds. The latter had 19,000,000 trees in 1913, 6,000,000 of which were the manihot glaziorii variety. There are other wild rubber plants—clitanria, ficus, castilloa, hevea, kickxia, etc. The best wild rubber is from near Tanganyika, Donde and Kilva.

Kamerun, in 1912, received \$2,730,389 for rubber (nearly one-half of total exports, rubber passing ivory).

Uganda had in 1916, 3,335 acres under native cultivation, to 5,706 acres (1917) under European.

Portuguese Africa mainly raises wild rubber. The Valour separator is coming into use in the M'punga forest.

Mozambique rubber is listed as "black" or "red" Africans. It is impure and cheap. Undeveloped good plants exist in quantity.

Madagascar forests are full of rubber plants, but the mixing of poor latex with good has lowered values. Re-foresting and cultivation can develop the great possibilities of the wild and plantation rubber.

Gambia has an indigenous vine, *Landolphia Hendelotii*, and many other plants, native or exotic.

Sierra Leone has the *Landolphia* and *Clitandra* vines, also the West African tree, *Funtumia elastici*. "Manoh twist" is made by stamping the coagulated latex with the feet, into cakes, which, cut in strips, are wound into balls.

The **Gold Coast** has trees and vines in extensive forests.

Funtumia Elastica is tapped as high as 50 feet, by the double herring system. The drip, unstrained, coagulates in a pit plastered with clay, producing an inferior rubber. New methods tend toward improvement.

Nigeria has done good work in educating the natives in rubber production. In the south there are nurseries for rubber seedlings. The northern product is inferior.

French West Africa made its first export from Guinea in 1888. All the other colonies are producing under strict laws.

Most of the **Senegal** rubber comes from Casamance. From 1896 to 1899 inclusive the average production of rubber in Casamance amounted to 252,936 kilograms annually, valued at 940,222 francs. For the whole colony the average production in the period 1896-1899 was 278,005 kilograms, worth 1,084,219 francs.

The rubber is derived from two species of *landolphia*, the most common known as toll, the vines of which grow in bushes on the plains and clearings. The latex is extracted from the roots. Although rubber has been cultivated in Casamance since 1883 there is no system of protection or propagation, and unless precautions are taken there is danger that the plant will disappear. The next most important variety is dob, which is less elastic, but which is in demand. Attempts to introduce Ceara rubber have been tried without success.

Congo rubber finds a ready market. It was formerly the chief producer of wealth. In 1907 there were 12,000,000 trees (estimated). United States and Liverpool buy the bulk of the production.

Rubber comes in balls, slabs, strips, rolls, cakes, twists and bags. The best of the African rubber comes from the Congo under such trade names as Wamba, thimbles, Equateur, kasai, Assiwimi, Nelle strips, Mongalla.

In 1907 the Belgian Congo exported 1,600 tons of rubber.

In 1914, the Belgian Congo exported rubber to the value of \$2,200,000.

In 1915, the Belgian Congo exported rubber to the value of \$2,300,000.

In 1915, Belgian Congo exported 1,929,199 pounds root rubber (876,909 kg.).

In 1915, Belgian Congo exported 2,864,270 pounds vine rubber (1,301,942 kg.).

Belgian Congo exported, 1920, rubber to the value of 5,396,397 francs (1,121,679 kilos).

French Congo, 1920, exported 2,122 tons of wild rubber.

In 1918 (first 6 mos.), Belgian Congo exported 12 tons of rubber goods.

In the forests of **Liberia** are to be found rubber-bearing vines and trees of 22 species. Liberia exported in 1910, 115,785 pounds of rubber; 1911, 103,032 pounds of rubber; 1912, 93,822 pounds of rubber; 1913, 116,712 pounds of rubber; 1914, 8,003 pounds of rubber; 1915, 10,081 pounds of rubber. In 1913, the value of the crop was \$30,000; in 1917, it was \$17,000.

In the southern part of **Abyssinia** are to be found many rubber plants but as yet of little value commercially.

SPICES

African countries do not rank in the foreground of trade in spices and herbs, like the East Indies, although there is not a spice known that can not be raised, and profitably so, in Africa. The negroes have long used herbs and have many superstitions concerning their curative, as well as their witch-like powers.

The ability of West Africa to keep the world supplied with pungent spices was the first inducement for the English to settle there, says Sir Henry Johnstone. Islands, like Mauritius and Réunion, are famous for their spices.

Mustard (*Sinapis nigra* and *S. alba*, from the natural order *Cruciferæ*) produces a small seed (proverbial in Scripture). It is beginning to be a paying commodity, especially in the south. Powdered mustard is used as a condiment on the table, for pickles, and medicinally.

Pepper has been used in India and other Asiatic countries for thousands of years. Peppers are of various kinds, as black and white pepper (*Piper nigrum*); long pepper (*Piper longum*), native of Malabar and Bengal; cayenne pepper (*Capsicum annum*). Black pepper is the dried fruit of the plant which bears it, and white pepper is made from the same berries.

Peppers of all kinds flourish in Africa, and form an article of export.

Melegueta Pepper or Grains of Paradise are the aromatic seeds of one or more species of the genus *amomum*, of the order *Scitamineæ*, both natives of **West Africa**. The seeds of both species appear to be used and sold commercially under the name of grains of Paradise. Pepper is widely distributed in **Sierra Leone** and **Lower Guinea** as far as Angola. It has never been cultivated in any quantity anywhere even in West Africa. In early days the spice was conveyed overland to Tripoli and shipped from Monti di Barca on the Mediterranean; as the Italians did not know whence it came they called it grains of Paradise.

In the 16th century English voyagers traded to the Gold Coast for gold, ivory, pepper and grains of Paradise. Now grains of Paradise are shipped chiefly from the settlements on the Gold Coast, the most important being Cape Castle and Accra.

Residents of hot climates crave highly-seasoned food. The natives of **Senegal** are very fond of pepper and it has been exported from Senegal.

CHILIES, RED PEPPERS

Red or cayenne peppers, under the name of chilies, are largely grown in the dry and rocky part of Zanzibar and Pemba. In 1906 chilies to the value of £19,000 were exported but the next export in 1908 was of the value of £485 only.

Sierra Leone pepper is yellowish red when dried, that of Zanzibar being dull dark red. Natal red pepper until recently supplied most of the bright red cayenne pepper in commerce.

Zanzibar chilies are considered the hottest in the world. This island exports annually nearly \$50,000 worth. New York controls the market for the exports. Chilies grow wild in East and Central Africa and are also cultivated in many sections. In 1917 there were 650 acres under chilie cultivation in Nyassaland. The pepper market of Sierra Leone has again been very good.

CAYENNE PEPPER is the finely ground powder of chilies or capsicum. Japan and Zanzibar pepper is made from "bird's-eye chili". The ripe fruits are dried in the sun, then in an oven. When dry they are ground to a fine powder and mixed with wheat flour packed in jars in a compressed state for exportation.

The chief use of capsicums is as a spice. **Cayenne Uses.** pepper is used for feeding birds and poultry also. In medicine it is chiefly used in the form of a gargle, occasionally as a liniment and internally to promote digestion.

Chilies and capsicums are cultivated all over the warmer regions of the world. The cultivation might well be taken up as a subsidiary or catch-crop, but should be rotated with other crops.

CLOVES

The **cloves** of commerce are the unopened flower buds of the aromatic clove tree (*Jambosa caryophyllus*).

The clove tree appears to be indigenous only to the Molucca islands. It was introduced into Zanzibar and Mauritius in the 18th century, and has there become the source of the largest part of the supply of cloves in the world. Penang cloves bring a higher price than those of Zanzibar.

Zanzibar cloves are very dry, larger and redder than **Pemba** cloves, hence are known as "Zanzibar redheads". Exports from Zanzibar in 1890 were 4,372,515 lbs.; from Pemba, 13,509,335 lbs. Zanzibar cloves lose about eight per cent. in weight on the passage to Europe. Besides the cloves, clove-stalks are shipped in immense quantities.

Cultivation in the **Seychelles** has been abandoned; also in **Réunion**. In 1904, 25,304 lbs. were exported from Réunion to France.

In **Madagascar** clove trees grow abundantly in wet sections and bring good returns, but as the tree is of very slow growth no great amount of capital has yet been put into them. In 1906 Madagascar exported over 100,000 pounds to France; in 1917, about 150,000 pounds.

The primary use of cloves is as a spice. **Zanzibar Uses.** cloves produce 15 to 17.5 per cent. of oil. The oil of **Madagascar** cloves is specially favored by French perfumers as having a particularly agreeable perfume.

Essence of cloves for flavoring purposes is made by dissolving four ounces clove oil in one gallon of spirit.

Cloves are aromatic, carminative and stimulating. Mother cloves are the dried fruits of the clove; they contain less oil than the buds but are exported for their oil.

GINGER

Ginger (*Zingiber officinale*) is an herbaceous perennial plant having a white, pungent, aromatic root covered with scale leaves which emits at intervals leafy stems usually about two feet tall and rather slender. It was one of the earliest spices known to Europeans. It is cultivated successfully in India, Malay Peninsula, China, Fiji and North Australia, in West Africa and as far south as Natal, in the West Indies and Central America.

Dried ginger is prepared for the market by scalding the roots in hot water, then spreading them in the sun to dry. Cured ginger is prepared by drying the roots in the sun each day for a week.

In Africa attempts have been made to cultivate the plant commercially in **Sierra Leone**. In 1906, 618 tons of dried ginger valued at £11,578 were exported. The cultivation here seems to be increasing.

The average price of ginger in the year 1916 was £36 a cwt., which is nearly double the average price during the preceding four years. As a result, the quantity exported from Sierra Leone rose from 567 tons, valued at £8,091 in 1915 to 971 tons, valued at £25,814. Of the quantity exported, 669 tons went to the United States and 289 tons to the United Kingdom.

In 1912, Sierra Leone exported ginger to the value of \$218,308; in 1913, to the value of \$172,587; in 1914, to the value of \$76,099.

Sierra Leone exported, 1920, ginger valued at £60,292 (1,432 tons).

Ginger is one of the most popular flavoring agents. Known, entering into confectionery, ginger beer, ginger champagne and other beverages. Oil of ginger serves as a basis for tinctures or essences of ginger. Ginger contains three valuable constituents, starch, oil and resin. Ginger is known as "coated" and "uncoated" or "peeled". The varieties of commerce are Jamaica, Barbadoes, Malabar, African and East Indian. Jamaica ginger is considered the best, but African is of good quality, some of it excellent.

The nutmeg (*Myristica fragrans*, or *M. aromatica*) is a small tree that furnishes two valuable spices—nutmeg and mace. When the fruit is nearly ripe the husk opens and shows a bright red network lining which covers a hard thin shell. The red covering is mace, the spice of commerce, and the shell under it covers the kernels or nutmeg, the other popular spice.

Mace possesses most of the qualities of nutmegs, though not in so marked a degree, and is used much in the same way. In countries where it is grown the entire fruit is boiled and used for food.

There are yearly exports of both nutmegs and mace from Zanzibar. The industry has been tried from time to time in West Africa with more or less success and possibilities in all that region are good. Mauritius and other islands have exports.

The Congo has small exports but the industry in this country is capable of rich reward.

Cinnamon is the inner bark of an evergreen tree (*Cinnamomum zeylanicum*), a native of Ceylon, where it has been cultivated for thousands of years.

Cinnamon is produced in considerable quantities in Zanzibar, Mauritius, Réunion and in the Seychelles, "a wanderer from the French gardens of the 18th century."

Allspice or Pimento (*Pimenta officinalis*) is the dried unripe fruit of a tree native to West India islands, whence it has spread.

Calabash (*Monedora myristica*) seeds are used as spice and are called calabash nutmegs; also used in medicine. In 1915, Gambia exported calabashes to the value of \$2,300. The dried calabash gourd is used for pipes, cups and many utensils.

HERBS

Cumin (*Cuminum cyminum*), native of Egypt and Syria, is a dwarf apiaceous plant long cultivated for its seeds, which have a bitter bug-like taste and aromatic flavor, good for seasoning. Cumin seed was well known to the ancients and is mentioned by Isaiah. It has been largely replaced in medicinal use by caraway seed, which has a more agreeable flavor. Cumin is exported to Europe from Morocco (\$46,000 worth in 1913), Sicily, Bombay and Calcutta.

Morocco exported, 1920, cumin valued at 2,370,317 francs.

Anise (*Pimpinella anisum*) is a small plant indigenous to Egypt and cultivated in Spain, Malta, and many other countries.

Turmeric (*Curcuma longa*), is an East Indian plant of the ginger family, raised chiefly for its aromatic root; it is found in northern African countries.

Caraway (*Carum carvi*) seeds are used for flavoring bread, cakes and other foods, and as a carminative. The plant is indigenous to the Himalayas and the Caucasus. It is also found throughout Siberia and Europe, and is extensively cultivated in Holland, England, the United States and Morocco.

Canary Grass (*Phalaris Canariensis*) seeds, used chiefly for caged birds, are raised in greatest quantities in Turkey, but also in less degree in California, Portugal and Morocco, which, in 1913, exported canary seeds to the value of \$107,000.

Chicory is dried fruit of ***Chichorium intybus***. It is native to Europe and Asia, but grows in the waste places of Africa and North America. Chicory is similar to the dandelion; its chief use is as a substitute for coffee.

Chicory is being cultivated in South Africa near Port Elizabeth. Modern machinery has been set up for preparing the root.

Coriander (***Coriandrum sativum***) is native of Asia. The aromatic seeds and dried fruit of this plant are used in medicine and for pastry, and other culinary purposes. Russia produces the greatest crop but Morocco furnishes the earliest crop, which is marketed in London in July and August, two months before the Russian importation. In 1913, Morocco exported coriander to the value of \$110,000.

Fenugreek (***Trigonella Fœnum-Græcum***) is the dried ripe seeds of a small herb which is native to southwestern Asia and extensively cultivated in Asia, Africa, and southern Europe. This aromatic product is chiefly used in medicines, but also by some cooks in certain food mixtures.

In 1913 Morocco exported fenugreek to the value of \$50,000.

DYES

Dyes are extracts from vegetation in which color is concentrated or from animals, but chiefly from coal tar.

These substances are used for coloring cloth, paper, leather, wood, hair, pictures. In order to make color permanent in the materials in which it is used, a "mordant", is used usually chemicals, as alum*, soda, Turkey red oil, tin, iron, tannin.

The dyes of Africa include indigo, Turkey red, henna, acacia, camwood, barwood, madder, galls, tumeric, safflower, saffron, rocou, archil, cochineal, sepia, mineral dyes.

Production of Dyes by Countries. **Indigo** (***Indigofera tinctoria***) is one of the best known colors. The extract of indigo is obtained from the plants by cutting them just after blooming, laying them in strata in a tank or vat, covering them with water, when they are left to ferment for from 10 to 18 hours. When ready in this state the mass is drawn into another receptacle

where it is constantly agitated until the blue color is thoroughly uniform. The water is then drawn off and the indigo is boiled to prevent fermentation, then dried and shaped into molds to be packed for the market. Indigo requires no mordant.

It is sometimes adulterated with earth, ashes or powdered slate.

Pure indigo is very dark—almost black—and it leaves no sediment in the water.

Indigo is chiefly produced in Bengal, Java, Philippines, Egypt, Abyssinia, West Indies and Central America. Indigo has been known in Egypt and the East from very early times.

Ribbons found on Egyptian mummies 5,000 years old preserve the blue color of the indigo with which they were dyed. The natural product is still used locally, blue being a favorite color of the Egyptians. In 1911 the exports of indigo amounted to \$125,900 in value.

In the **Congo** indigo has long been raised, but has fallen off in production and exportation. It grows well in all tropical countries of Africa and is raised chiefly by native labor. Much of the coarse cotton cloth made by the natives is dyed a deep blue with indigo.

In **Senegal** indigo was raised many years ago for dyeing cotton cloth, but the first cotton experiments in this country failing to produce paying results, indigo cultivation also fell off.

As a local product of consumption, indigo is especially cultivated in the river regions. A European, Mr. Mohler, a farmer at Kouma (1888), declared that 40 meters cultivated in indigo yielded him 92 breads which sold for 0 fr. 25 per bread at Dagana.

Indigo bread from **Senegal** finds favor in Europe, though said to contain many impurities.

In **Nigeria** indigo grows wild and is cultivated in small patches by the natives.

In West Africa indigo is grown in several sections and in **Gambia** is commercially important.

The **Cape Verde Islands** produce indigo in less quantities than formerly.

Madder (*Rubia tinctorum*) is a perennial herb, native to the Levant, and cultivated in many countries. The roots are long and slender and bright blood red. The fresh roots contain a yellow coloring matter. **Alizarin**, which constitutes its most important property, crystallizes into orange-red needles soluble in boiling water, alcohol and ether. Coal tar has greatly displaced the vegetable product.

Several other dyes are prepared from other species of the madder family, namely **morinda** (*M. citrifolia*). This dye is said to be useful in guarding against insects. It is also used as medicine. Besides yellow, every shade of red, purple and lilac can be obtained from the madder family.

Madder roots are obtained throughout **Central Africa**.

Henna (*Lawsonia inermis*) is a fragrant white flowering shrub of Southern Asia and adjacent regions, which produces from its leaves a reddish-orange dye. Henna is used by the Buddhists and Mohammedans in their religious ceremonies. It is the ancient gopher-wood of Scripture.

Both Orientals and some African natives stain their teeth and finger-nails an orange brown with it. Henna is used commercially for dyeing wool, horse hair, leather and by modern coiffeurs for coloring hair several shades of yellow, orange and golden-brown.

In **Egypt**, henna is grown extensively and has been cultivated for centuries. It is also grown in **Abyssinia**, **Soudan** and **Somaliland**.

In 1914, 1,000,000 pounds of henna were exported from Tripoli.

Acacia (*A. arabica*), or babul tree, belongs to a very large family of trees (**Leguminosæ**), 450 species of which are found in the tropics of the earth, mostly in Australia and Africa. The bark of this tree is used for tannin and for dye and the leaves afford a yellow dye. This dye is produced in **Senegal**. Black dye from the bark is used to make a kind of ink also, and the natives use it in both tanning and dyeing hides.

Camwood (*Baphia nitida*) produces a rich red dye, used slightly in commerce, but more particularly by the negroes. The powder is sprinkled over their bodies or, mixed with oil, is smeared on them.

When camwood is scarce henna is used in its place but is not nearly so favored as the red of the camwood. This tree is indigenous to Nigeria, Angola and West Africa.

An inferior dye from the same tree, not so rich a red, but much used, is **barwood**. The red of this dye borders on orange. Another dye, ranging from pink to rose color, is obtained from **rosewood**.

Tumeric (*Curcuma longa*), a plant belonging to the ginger family, native to East India, but introduced into several African localities, produces a yellow dye.

Safflower (*Carthamus tinctorius*) is a thistle, with a large orange-colored flower, native to India, Persia and Egypt, where it has been cultivated for a red dye obtained from its blossoms.

Saffron (*Crocus sativus*), a crocus having purple flowers, is widely cultivated in Mediterranean countries. The stigma of this flower yields an orange color which is chiefly used in confections and varnishes.

Galls are excrescences formed on several trees by insects belonging to the order **Hymenoptera**, and allied to the wasps. These galls are found abundantly in African countries, as Morocco and Algeria, and are much used for making dyes and ink.

Argols, or **lees**, which are deposited as a crystalline coating in casks of new wine, make the commercial source of tar-taric acid and tartrates, which are used as mordants in dyes.

In 1915, **Algeria** exported tartar, crude and wine lees, 5,218 tons, valued at \$945,507; and in 1916, 4,409 tons, valued at \$1,018,654.

Rocou or **Arnotta** (*Bixa Orellana*) is a shrub or small tree, native of tropical America and extensively cultivated there as well as in tropical African countries, for the red dye produced from its seeds. Rocou has diminished in commercial importance but is considerably used in countries where it is grown and extracted, for dyeing silks, feathers, leather (russet) bone and ivory, and also as coloring matter for cheese and butter.

Archil or **orchil**, is a lustrous violet dye obtained from **Roscella tinctora**, *R. fuciformis*, and **Lecanora tartarea**. Archil is used as a coloring agent in pharmaceutical preparations and various pigments. These dyes are obtained particularly in **Angola**, **Mozambique** and **Madagascar**.

Of animal dyes two are of especial importance, cochineal and sepia.

Cochineal (*Coccus cacti*) is a tiny insect belonging to the plant lice, which furnishes a widely-used red dye. The cochineal is a native of Mexico and Central America, but has been introduced into the East Indies, Algeria and the Canary Islands.

In 1913, the **Canaries** exported cochineal to the value of \$75,124, but war greatly reduced the export.

Sepia, which has been described in the chapter on Fish, is a valuable black or very dark brown secretion of the cuttlefish.

Coal tar has thousands of compounds to its credit, the colors alone numbering several hundred. These dyes are known as anilines, anthracenes, alizarines, eosines, and produce all colors and shades.

White lead makes the best white paint yet produced. Lead also furnishes an orange pigment and chrome yellow.

Zinc produces a sulphate which is an important pigment, although it has less value than that of lead.

From **Copper** is obtained blue vitriol.

DRUGS

Originally drugs meant only dry herbs, but now they include many substances of the vegetable, animal and mineral kingdoms used in medicine.

Plants afford the greatest amount of medicines, which come from the roots, sap, bark, twigs, leaves, fruit, seeds and blossoms.

In 1915, **Algeria** exported 242 metric tons of medical herbs, flowers and leaves, valued at \$123,906; in 1916, 391 metric tons, valued at \$210,000.

Some of the plants from which drugs are obtained in Africa are as follows:

The **madder** family, which furnishes a great variety of drugs, comprises about 350 genera and 5,000 species. Important specimens are **Mitchella repens**, **Galium**, **Cephalanthus**, **Pseudocinchona Africana**, indigenous to Africa, used in the treatment of fever; **Krausia coriacea**, a poisonous

species, but used medicinally in small quantities. *Sarcocephalus esculentus*, of West Africa, is used as a refrigerant, and as a tonic. This bark is chewed by the natives.

Nauclea inermis, is used in the Soudan as an anti-emetic and to allay rheumatism.

Henbane (*Hyoscyamus meticus*) grows wild in Egypt and the Soudan, and eastwards to India. In 1902 the attention of British alkaloid manufacturers was drawn to Egyptian henbane for its excellent quality.

In 1915 dried henbane brought in London markets about \$74 per ton. In 1916, there were considerable exports from both Egypt and Soudan, high in quality, and that of Egypt pronounced even superior to Indian henbane which has long ranked first.

Aloe (*Aloe barbadensis* and *A. capensis*) is a liliaceous plant resembling the century plant, from which a much used drug is obtained. The plant yielding **Socotrine aloes** is native to East Africa, and this is the chief source of supply of the United States. That yielding **Barbadoes aloes** is native of Northwest Africa. Aloes are used in "bitters" and as a bowel medicine, often given in pill form.

In 1916, South Africa exported 986,939 pounds aloes, valued at \$45,283; in 1917, 752,638 pounds, valued at \$33,-749.

Cinchona (*Cinchona succirubra*) produces the most important bark used medicinally. The cinchona is native to the Andes of Peru and Bolivia, but cultivated now in India, Java, Japan, Abyssinia, German East Africa and the West Coast of Africa. This bark is valued for three alkaloids—quinine, quinidine and cinchonine—the three properties considered most effective in counteracting malarial affections and intermittent fevers.

The **Cape Verde** and **Canary Islands** produce quantities of cinchona bark, and sell to Equatorial Africa, where white residents take from one to 10 grains of quinine every morning.

The price before the war was 1d. per pound in Africa. It is now 2½d. per pound, and 8¾d. per pound in London.

The "hard pear" tree (*Strychnos henningsii*), a tree found in South Africa, furnishes a bark which, extracted with alcohol, is used in the preparation of an "appetizer bitter." The natives use it medicinally and in veterinary practice.

The bark of "Knysna boxwood" (*Gonioma kamassi*), also of South Africa, has a small amount of alkaloid, used to a small extent in tonics.

Rhizones (*Kaempferia ethelæ*), known locally in South Africa as "sherungulu," possesses fragrant tubers, used by natives of the Rand as medicine.

Datura (D. stramonium), a species commonly known being the jimson weed, is another source of hyoscyamine. This is successfully produced in Egypt, Soudan and South Africa.

The *jatropha (Jatropha curcas)*, or Indian physic-nut, is one of the plants which the Administration attempted to develop in the colony of Senegal. This plant and its products make an important commercial output of the Cape Verde islands.

The *Calabar bean (Physostigma venenosum)*, a native of West Africa, produces a poisonous bean used by ophthalmologists to contract the eye pupil.

Nux Vomica (Strychnos nux vomica), is a medicine much used and recognized in all pharmacopoeias. It is obtained from the seeds of a small, straggly tree of India, Ceylon, Cochin China, North Africa and Australia.

The oils of several plants are used as medicine, notably that of the *castor (Ricinus communis)*. The castor plant is indigenous to or naturalized in all tropical and semi-tropical countries. It is extensively grown in many African countries for the oil which is used medicinally, but more especially for industrial purposes, and especially for airplane lubrication.

Opium, the dried juice of the *poppy (Papaver somniferum)*, is grown in Asia Minor, Turkey, Egypt, Persia and India.

Laudanum is made from this plant.

Egypt once had a large opium trade but it has become greatly lessened, although considerable opium is still prepared for the market.

Cocaine is an alkaloid obtained from leaves of the coca shrub more common in South America than Africa, and is

used largely as an anesthetic. Taken in large quantities cocaine is an intoxicant and very injurious to the human system.

Several animal oils are used as medicines, notably that of certain fishes, but this industry is negligible in Africa.

From African minerals, are produced salts of several kinds: arsenic; tincture of iron, used largely in tonics with vegetable bitters; mercury, used in medicine as calomel; and various preparations made from coal-tar.

SUGAR

Sugar is chiefly derived from two sources, the sugar cane (*Saccharum officinarum*), and the root of the beet (*Beta vulgaris*). The sugar cane is a native product of India, but by cultivation has spread to all tropical and semi-tropical regions of the earth. Beet sugar was not produced in Africa (Algeria) until the war.

The moisture required for sugar-cane growing runs from 50 to 65 inches annually and thus limits the localities in Africa suitable for its production.

The chief centers of cane sugar industry are Natal, Mozambique, Madagascar, the lower Nile valley, the Coast of Nigeria, French Guinea, the Congo and Angola.

Sugar is extensively cultivated in the islands off Africa. The French introduced it into Mauritius and Réunion in the 18th century, and it is now one of the chief productions of both the islands. In 1913 Mauritius produced 3,699,749 hundredweight of sugar, and in 1915, 4,440,467 hundredweight, valued at \$17,551,882. In 1916 Mauritius exported sugar to the value of \$22,500,000.

In Réunion the yield of sugar is 64 per cent. of the cane. There are 62,000 acres of sugar in Réunion.

Madagascar has many thousand acres in sugar-cane.

The Egyptian delta is a great sugar-cane raising country and has for many years had a large annual output. During the years 1909-1913, the annual average export of sugar was 16,171,000 pounds. In 1916, Egypt exported 63,533,000 pounds of cane sugar valued at \$3,000,000, approximately, and in 1917, 57,296,000 pounds, valued at \$4,462,024.

Sugar cane is found extensively in the moist regions of the upper Congo, where it grows wild and is used by the natives for chewing and for making wine. From the molasses

rum is produced. But although easily raised here sugar does not seem to have much promise of future development in the Congo. In the first half of the year 1918, Belgian Congo exported 130 tons of sugar.

Senegal, in 1914, exported 262,968 pounds of cane sugar valued at \$13,000. Sugar, introduced into this country from France, is so commonly grown that it is very cheap and consumed in large quantities.

Mozambique has a sugar factory in Duenu. In 1915 Mozambique exported sugar to the value of \$614,754.

Angola, in 1914, exported 4,554 tons of sugar, valued at \$410,111, and in 1914, 2,960 tons, valued at \$213,913.

The confectionery business in the **Union of South Africa** is rapidly increasing and extending in all directions. Fine chocolates and other candies are now made and boxed attractively.

In 1913, the Union of South Africa produced 1,730,000 hundredweight of sugar; in 1915, 2,000,000 hundredweight. In 1916, the Union of South Africa exported 3,550,673 pounds valued at \$209,912, and 8,597,165 pounds sugar products, valued at \$140,817. In 1917, 4,145,025 pounds sugar, valued at \$301,801; and 433,193 pounds sugar products, valued at \$13,743.

The output of sugar for 1920 from **Union of South Africa** was 189,183 tons.

Natal has by far the greatest sugar output in the **Union of South Africa**; in 1918, 130,000 tons. The first crop of sugar was raised in Natal in 1861. The yield has steadily increased.

Abyssinia has not until recent years cultivated sugar-cane to any extent; now the annual output of sugar is increasing rapidly.

The world production of sugar in 1915 is given as 16,806,000 long tons, which is divided about half and half between beet and cane sugar. Cuba and India rank first as cane-sugar producers; Java third; Hawaiian Islands fourth Porto Rico fifth.

The cane is generally ripe for harvest at from twelve to sixteen months' growth. It is cut close to the ground just before its flowering time, being then heaviest in juice. The stubble develops new cane, the plants thus continuing for several years.

The tops are sliced off the cane immediately after cutting and the leaves are stripped off, only the denuded stalks being transported to the mills. An average analysis of high grade stalks in this condition shows about 72 per cent. water, 18 per cent. sugar and 10 per cent. woody and vegetable matter.

Two different processes are in use for extracting cane juice—"milling" and "diffusion". By the "Milling Process", the stalks are unloaded from wagons in huge bundles, often weighing five tons or more, into a "hopper", or onto a "carrier" which transports them to a "shredding" machine or a "crusher". They go next to the roller mills. The first mill extracts probably 60 per cent. of the juice. The "bagasse", as the crushed stalks are called, is then sprayed with water and put through a second, and again, a third mill, after which the stalks are consumed as fuel in furnaces.

For the diffusion process, the cane-stalks are sliced thin by cutting machines. The "chips" or pulp go to a series of large tanks called "diffusers" or "cells," where steam or water saturation extracts the sucrose.

The juice obtained by either process is of a sweetish taste and the appearance of sweet cider. It is pumped into tanks called "defecators," to remove impurities. It then commonly undergoes two or three other purifying processes, by evaporation, or through filters, before it is ready for the multiple vacuum boilers, where it is condensed to syrup.

Next comes the separation of whatever proportion of uncrystallizable syrup is mixed with the crystals now generally accomplished by centrifugal machines—a wide-sided, cylinder-shaped basket of fine mesh is revolved at high speed inside an iron casing, and the syrup ejected into the casing, whence it drains into a receiver. The "cured" sugar left is known as **Centrifugal**, or "Raw" sugar, or locally as "Brown Sugar".

BEANS

All pulses, including peas, beans and lentils, belong to the pea family (**Leguminosæ**), and the seeds of all the various species form very important articles of diet the world over. Beans form the most important commercial pulse product.

Leguminous seeds are essentially nitrogenous and contain more proteins than other vegetables, the proportion in the dried seeds ranging from about 20 to 28 per cent., and carbohydrates from 45 to 60 per cent. Amount of oil is low in the different kinds.

Beans (Fabaceæ) are the seeds of certain leguminous plants, the species most commonly known being the broad bean (*Vicia faba*), including lima, kidney, sieva, string beans.

The **broad or horse bean**, known also as the **field bean** (*Faba vulgaris*) is a hardy annual belonging to the shores of the Caspian sea, but has been introduced into many countries south of that region.

The **soya bean** (*Glycine hispida*) grows on a dwarf bush covered with fine brownish hairs. This bean is a native of China and Japan, whence it was introduced into India and northern Africa, and has now become popular all over the world. It constitutes the most important pulse of the Far East, where little meat is eaten. These beans contain more oil than other beans. The cultivation of soya beans has been encouraged in South Africa by irrigation schemes.

The **haricot, kidney or French bean** (*Phaseolus vulgaris*) is probably of Asiatic origin. It is now grown in all temperate climates; many varieties have been produced, all of which are red or reddish color. This bean is very nutritious, easily raised and is becoming one of the most important food products of Africa, particularly in Madagascar. In 1913 imports of haricot beans into the United Kingdom from Madagascar were 71,820 hundredweight; in 1916, 138,570 hundred-weight.

The **carob bean** (*Ceratonia siliqua*) or "St. John's Bread", was introduced into Africa from countries across the Mediterranean. The carob is a tree and bears long pods, which contain a very nutritious bean, used more particularly for horses and other animals, but also largely as a human food. This bean is extensively raised in Algeria and Morocco.

Countries. The world's supply of beans comes chiefly from China, India, Turkey, Russia and Egypt. In 1915 more than half the total imports of Great Britain were from British India and Egypt.

Egypt grows many varieties and was the chief source of extension of the industry throughout Africa.

In 1915, Egypt exported to England 377,660 hundred-weight of beans, valued at \$1,583,597; in 1916, to England 333,460 hundredweight, valued at \$572,428 (a war emergency crop).

Morocco produces great quantities of beans, largely for local use, but for export also. In 1913, Morocco exported beans to the value of \$61,000; in 1914, 900 hundredweight; in 1915, 53,640 hundredweight, valued at \$207,000.

Morocco exported, 1920, beans valued at 31,140, 780 francs.

Tunis has many acres in beans, where most varieties grow luxuriantly. They are used much in the country for food, and exports sometimes amount to sizable quantities. In 1915, Tunis exported 10,192,393 pounds of beans, valued at \$232,000.

In Congo, beans are raised everywhere by the natives.

In Portuguese Africa the bean industry goes far toward feeding the population and domestic animals; beans and bean products are among the exports.

In 1913, Angola exported 551 tons of beans, and in 1914, 833 tons.

In Mozambique beans grow abundantly and thousands of acres are under cultivation. In 1914, Mozambique exported Kaffir beans to the value of \$100,000; in 1916, 4,500,000 pounds of Kaffir beans.

In British East Africa many kinds of beans are grown. They are largely cultivated by the natives but receive much attention from white farmers also, both for local food and trade. In 1917 there were 105,612 acres in beans in Uganda.

Besides furnishing human food in enormous quantities, **Uses.** beans are used in feed for horses, cattle, sheep and hogs, while the leaves and stalks are used as fodder. Bean stalks make an excellent fertilizer and are often plowed in to fertilize the ground for a wheat crop to follow their harvesting. The stalks are also used for making paper.

The Lima or Duffin bean (*Phaseolus lunatus*) is native to South America, as the name implies, and is now distributed throughout warmer portions of the world. Under cultivation the seed has become much larger and fuller and the color has been changed from purplish red to white.

Beans have flourished in **Madagascar** almost since they were introduced in 1864. The lima bean was the first bean introduced and became so abundant and such a good article of trade, as to take the name of Madagascar.

In 1912, Madagascar exported 6,073 metric tons of lima beans, valued at \$561,200; in 1913, 141 metric tons, valued at \$689,000; in 1914, 8,561 metric tons, valued at \$702,000; in 1916, 11,571 metric tons, valued at \$1,228,377. In 1917, 15,000 tons of beans. The average yield of beans in Madagascar in 1917 was 426 pounds to the acre.

Algeria, in 1915, had 136,000 acres in beans. In this country the locust bean makes a very valuable fodder, for home use as well as for exporting. In the year 1900, 140,000 hundredweight was produced and the government is trying to promote the planting of these trees by offering prizes.

Beans are grown on the smaller islands, a bean especially favored in **Mauritius** being the small Indian rice bean, which supplies home demands and leaves a good many tons for export.

The African **Calabar bean** is described under the chapter on drugs.

The **moth green gram or mung** (*Phaseolus mungo*) beans grow wild all over India, their native home, and have been cultivated over 3,000 years. These beans have been introduced into all African tropical and sub-tropical countries.

The **rice bean** (*Phaseolus calcaratus*) is another small bean found wild and cultivated in India, which has been introduced into Africa and adjacent islands.

The **vetch** (*Vicia sativa*) is a small wild species of bean which is used principally for feed for horses and cattle, but is used for human food also. It is grown in northern African countries.

PEAS

Of the great family of peas two varieties are most important. **Pisum sativum**, the garden or common pea which grows wild in India and the Far East, is called the parent of all garden peas. This pea has been cultivated from very remote times for food, both green and dried. The other chief species is **Pisum arvense**, the gray or field pea, which is a

dwarf plant having purple or pink blossoms, and possessing leafy, persistent stipules. They grow wild in Greece and the Levant. These peas are more hardy than the garden species and require less care.

The gram or chic pea (*Cicer arietinum*) is an annual herb, cultivated from remote times in warm countries. This pea was known to the ancient Egyptians, Hebrews and Greeks. They are now extensively cultivated in many African countries, particularly in the Mediterranean littoral.

The pigeon pea (*Cajanus indicus*) is a sub-shrubby plant, often six feet in height. It was introduced into Africa from India.

These peas are yellow and veined purple. England imports great quantities from her colonies for cattle food.

Closely allied to the bean is the cow pea (*Vigna catia*ng) which is popular in tropical countries, furnishing much of the food in those regions. The pods grow from one to two feet in length.

Countries. In all of the tropical and sub-tropical countries of Africa both peas and beans luxuriate. Light humid soils suits them best.

In British East Africa peas are widely cultivated and grow in abundance; particularly well in Uganda, whence they are exported largely to England.

Other East and West African countries have many acres in peas.

The Mediterranean countries all raise great quantities of peas.

In 1913 Morocco exported chick peas to the value of \$151,000.

In Madagascar peas thrive but are not so extensively raised in the islands as their cousins, the beans. It is claimed that peas have made the fortune of Southwest Madagascar in the last few years. In 1912 Madagascar exported peas to the value of \$538,000.

LENTILS

The other important member of the pulse family is the lentil (*Lens esculenta*). These seeds are also called vetches in some localities. Lentils have whitish or pale blue flowers. The pods are short and broad containing two flattened seeds. There are two kinds of lentils, French and Egyptian.

Lentils were introduced into Egypt from Western Asia at a very early period, and from this country they have spread to other African countries and beyond to the islands. Egyptian lentils are small and brown, with orange-colored interiors. They are usually sold in the "split" form.

COFFEE

The coffee-bean of commerce from which is decocted the popular beverage, is the product of *Coffea arabica*, a rubiaceous plant indigenous to Kaffa, a province of Abyssinia, from which the name is derived. In the eleventh century Arabs took wild seeds which at Mocha developed a finer grade. Four hundred years later the Arabs returned the improved seed to Abyssinia, which now produces the finest (Harrari) coffee in the world. Wildberries, "Abyssinian coffee", are exported, but the cultivated Harrari or "long-berry Mocha" is distinguished. High land (6,000 feet) produces the best coffee.

The world's coffee production amounts to nearly 3,000,-000,000 pounds per annum. Brazil is accredited with 73 per cent. of the whole output; other countries producing from 3 per cent. to 4 per cent. are Dutch East Indies, Guatamala, Colombia, Venezuela, Mexico, Salvador, Porto Rico. The total product from Africa, including wild and cultivated, is not more than 2 per cent. The countries of Africa producing this berry in the order of importance are Abyssinia, Angola, British East Africa, Liberia, Somaliland, Belgian Congo, Mozambique, Madagascar, German East Africa and colonies on the West Coast.

Coffee is indigenous to **Angola** and has long been an article of commerce of this colony. In 1890, coffee was exported to the value of \$760,000. In 1913, there were 5,001 tons exported, valued at \$899,779, while in 1914, the output had diminished to 4,338 tons, valued at \$487,443.

Senegal grows coffee, but this country pays more attention to a coffee substitute, **bentamare**, a product which has long been known in the commercial world as a coffee substitute. It is also used as a therapeutic by the natives.

Uganda exported coffee in the year 1917 valued at \$500,000.

In **British East Africa**, the price of virgin soil suitable for coffee plantations is now \$60 per acre. The coffee yield when in full bearing is about half a ton per acre, and it is worth about \$300 per ton.

In 1915, Mombassa exported coffee to the value of \$341,-804.

British East Africa (Kenya) exported, 1920, coffee to value of £574,884.

Coffee is native to the **Congo** in Ubangi, the forests of Lusambo, Lomami and certain of the river islands. Many varieties of this wild coffee have been observed and two of them have an aroma and taste quite remarkable.

Coffee may be considered as one of the farming industries with the greatest future in the Congo.

In 1897, coffee cultivation began to take on importance.

A million and a half plants were distributed in the districts of the Equator and Bangala and at Stanley Falls.

At present the great centers of coffee culture are found in the Mayumbe, in the zone of Stanley Falls and in the districts of the Equator and Aruwimi. The harvest of 1903 yielded only 19 tons on account of the drought. The Congo exported 160,000 pounds in 1906.

The plantations are composed almost entirely of coffee trees of the species *coffeea liberica*.

A central plant established at Kinshasa treats the coffee by a dry process and prepares it for sale; a part of it is roasted and sold in the Congo itself, the rest is exported to Europe.

In 1902, the plant furnished a total of 149,670 kilos.

A substitute for coffee, much used in South Africa, either as an adulterant or as mock coffee, is chicory.

**Coffee Production in Pounds
(From Statistical Abstract)**

	1913
Union of South Africa	36,087
Nyassa and Protectorate	192,076
Uganda Protectorate	1,372,224
E. African Protectorate	708,000
Nigeria	9,828
Sierra Leone	17,096

Islands off the coast of Africa have for many years raised their own coffee. Madagascar, in 1917, exported 1,300,000 pounds of coffee.

The **Canary Islands** raise quite a supply of indigenous coffee, and one of the chief products of the **Cape Verde islands** is coffee. The industry in these islands dates back to 1790, and at the present time coffee is the chief resource of the people in Santo Antao, Fogo and San Thiago.

Future of Coffee. The coffee tree in **Liberia**, finds in the great equatorial forest the soil and climate which suits it the best. If over-production in Brazil does not allow at present the sale of coffee at remunerative prices, this situation will soon stabilize itself.

Robusta coffee is native to Congo. A plantation five miles from Stanleyville in the Congo is trying out 15 varieties of coffee.

In 1911, **German East Africa** exported 2,593,841 pounds coffee, valued at \$75,000; in 1912, 3,473,188 pounds coffee, valued at \$90,000.

In 1914, **French Somali** exported coffee beans to the value of \$1,600,000.

In the year 1914, **Nyassaland** exported 192,074 pounds coffee; in 1917, 131,390 pounds of coffee.

In the colony of **Ashanti** in 1916, a coffee-mill was set up and the first export product was made by the Swanzy Company in competition with tinned coffee, which is a considerable import.

Coffee grows well in many parts of the **Union of South Africa**, but most of the output is used for home consumption. A good deal is exported, however, although other kinds are imported into the colonies. In 1916, the Union of South Africa exported 1,074,580 pounds, valued at \$150,000; and in 1917, 839,439 pounds, valued at \$136,034.

TEA

Tea is the most popular beverage. It is prepared from the leaves of the order **Ternstromiaceæ**.

The world production of tea cannot be accurately estimated because such great countries as China and India consume immense quantities which are not tabulated. These two countries export about 250,000,000 pounds each per year, followed by Ceylon, Japan, Java, Formosa and Malay islands.

The tea-producing countries of Africa are Natal, Mozambique, Rhodesia, Congo and Madagascar, which are almost negligible in estimating the world's total.

One advantage of African tea which is likely to grow in popularity as people grow more and more opposed to narcotics, is its freedom from tannin, but this very absence causes habitual tea drinkers to pronounce the taste of African tea peculiar. Tea planters willing to persist in the culture of this plant may yet make the African brands popular.

Union of South Africa Produced in Pounds (Statistical Abstract)

	1913	1915
Natal	1,687,729	1,800,000
Nyassaland Protectorate..	215,040	288,341

In 1916, the Union of South Africa produced 5,501,091 pounds. During the first six months of 1918, Belgian Congo exported 10 tons of tea. In 1914, Nyassaland exported 116,074 pounds tea; in 1917, 420,685 pounds.

From 3,740 acres of tea **Union of South Africa** produced, 1920, 5,168,419 lbs. (green leaf).

COCOA

The raw cocoa of commerce is the seed of trees of the genus **Theobroma**. All are natives of tropical America. The *Theobroma cacao*, which means "Cocoa, the food of the gods," is a small spreading tree which is usually not over 20 feet in height and which is artificially kept lower in plantations.

A minimum temperature of 80 degrees, and plenty of moisture, both of soil and atmosphere, are required to bring out their full bearing possibilities. The trees begin to bear fruit at three or four years, continuing to the age of about forty years. Some fruit is ripening all the year round, but two main crops are gathered, generally in June and December.

The cocoa beans or seeds are found in pods of varying shapes from seven to twelve inches long. The ripe pod is dark yellow or yellowish-brown in color with a thick, tough

rind enclosing a mass of cellular tissue. The beans, about the size of almonds, are buried in the tissue. Each pod contains some 60 seeds. When fresh they are bitter in taste, and of a light color, turning reddish-brown or reddish-gray during the processes of sweating and curing.

The ripened pods are left on the ground for twenty-four hours to dry. The next operation is the "sweating" or curing. The acid juice which marks the beans is first drained off and they are then placed in a sweating box, great care being taken to keep the temperature from rising too high.

The final plantation process is the drying of the mass in the sun. In the cocoa and chocolate manufacturing establishments the beans are cleaned, sorted and roasted—the roasting being more important, for upon it depends to a great extent the flavor of the finished cocoa.

Chemical Analysis. Cocoa contains a percentage of theobromine which corresponds to the stimulating properties of tea and coffee, but its high merit lies principally in its very large proportion of nutritive substances—roasted cocoa beans contain an average of 49 per cent. pure oil, 18 per cent. protein matter, 10 per cent. starch, and 7 per cent. other carbohydrates—contained in a form which is very palatable. In Europe and the United States, chocolate is a part of the army ration as a food and of the navy ration as a beverage.

The United States is today the largest cocoa consuming country in the world. During 1910, more than 115,000,000 pounds of cocoa beans were imported into the United States—nearly one-third of the entire world production. The source of the United States supply has been chiefly South America, but during the war importations came from **West Africa**, which now supplies one-third of the world's cocoa, having surpassed Ecuador.

In 1909, there were 20,312 acres planted to cocoa in **Fernando Po**, and the production for 1909 was 6,058,840 pounds, increasing steadily each year since 1905.

The island of **St. Thomas** produced, 1916, 629,450 bags of cocao weighing 135 lbs. each.

Experimental cultivation of cocoa has been in progress in the **Congo** since 1908. Within the last few years Mayumbe has become an active center of the cocoa industry. The pro-

duce appears to find a ready market in Antwerp, where it fetches from \$272 to \$370 a ton. With the northward advance of the Mayumbe Railway, fresh fields for this industry will be opened up in the Lower Congo. At Mayumbe, climate, soil, labor and transportation are favorable. Drought is the great enemy of cocoa.

The rapid progress realized in cocoa cultivation Future of in the last ten years augurs well for its future. Cocoa. Cocoa is at present the only economic plant largely cultivated susceptible of furnishing certain results under normal conditions for production; it may be considered a basic element of Congolese agriculture.

The cocoa plantations existing now in Mayumbe cover only a part of the available soil of that region. Exploitation will be easy, certain and remunerative. From 1896 to 1906, cocoa exports increased from 92 kilos to 402,429 kilos.

While in 1906, the average price was 1 fr. 80 per Prices. kilogram, it rose to 2 fr. 84 in 1907; on December 5, of the same year it was 2 fr. 05.

In 1915, Belgian Congo exported 1,363,601 pounds cocoa; 1916, 1,694,000; 1918, 1,505,280 pounds.

The quantity of cocoa exported from the Gold Coast during 1910 is estimated at 50,692,949 pounds, valued at \$4,217,389, as against 42,277,606 pounds, valued at \$3,675,896, in 1909.

The cocoa returns for Ashanti for 1910 show 1,914 tons, as against 1,790 tons in the preceding year.

The spread of cocoa disease, which unfortunately is prevalent in the Central Province, does not seem to have damped the ardor of cocoa growers so far.

In 1915, Gold Coast exported cocoa to the value of \$17,767,425; in 1916 72,161 tons, valued at approximately \$19,000,000; in 1917, 22,373 tons, valued at \$300,000.

Gold Coast exported, 1920, cocoa to the value of £10,056,298 (124,773 tons).

Cocoa constituted 62 per cent. of the exports of Gold Coast in 1915. Lack of transportation during the war curtailed the output immensely.

The price of cocoa has steadily fallen, one important producer stating: "The average price for the last 10 years has been \$13.60 per 100 pounds; and for the last five years \$11.80 per 100 pounds."

Cocoa lands are sold by area, the price varying according to their estimated fertility. The very best plantations are valued at \$485 an acre. Each 250 acres, well planted, has about 53,000 trees and should produce about 88,000 pounds of cocoa.

In 1915, **Nigeria** exported 182,095 hundredweight cocoa, valued at \$1,527,666; in 1916, 179,121 hundredweight, valued at \$1,912,800.

Experiments in Nigeria resulted in an average of 5.92 pounds per tree per annum and an annual profit of \$20 per acre.

Nigeria exported 1920, cocoa to the value of £1,237,538.

In Kamarun the production of the cocoa palm and kola are largely in the hands of the colored population.

Seventy-seven thousand eight hundred sixty-seven kilos of cocoa beans from **Madagascar** were exported in 1917.

The **Cape Verde Islands** contain much wild cocoa and considerable is cultivated, but the output could be much larger.

Liberia cultivates considerable cocoa, most of which comes to the United States.

Use of Cocoa. The ground cocoa bean, from which part of the oil or fat has been extracted, is sold in powdered form. Because of the smaller quantity of oil, cocoa is more acceptable to many digestions than the richer chocolate.

Chocolate: The ground cocoa bean, generally in cake form, sweetened and unsweetened, flavored and unflavored, for cooking and eating.

Powdered Chocolate: Sweetened chocolate of varying styles and compositions, sold in a pulverized condition.

Milk Chocolate: A compound of milk powder and the ground cocoa bean, sweetened and flavored.

Cocoa Nibs: The cracked cocoa bean, cleared of chaff, shells.

Cocoa Butter: The fat or oil extracted from the cocoa bean. It has high commercial value, and is employed in confectionery, especially in covered candies, such as chocolate creams, but a considerable quantity is used in the druggist's trade—in the manufacture of toilet preparations and cosmetics.

Chocolate for a long time has been recognized as possessing high nutritive qualities in concentrated form, and it is a staple part of the contents of the pack of mountain climbers and polar explorers. The importance of chocolate and cocoa for army and navy purposes was recognized by the War Trade Board in laying out its policy with respect to the restriction of imports.

There is a project for a valorization committee to establish a minimum price for cocoa and to stabilize the trade, similar to the plan adopted for the valorization of coffee in Brazil. Portugal, Ecuador and Brazil are the chief parties to the agreement and will control over one-half of the world's output. Cocoa producers are realizing a profit of 75 to 100 per cent. net.

Cocoa has long been regarded as one of the foremost staples of international commerce. The United States is buying twice as much as before the war. In Europe, the principal markets are Hamburg, Havre and London.

When shipping facilities are restored New York is likely to be an important cocoa distributing center.

World's Production of Cocoa

Countries	1915
	Metric Tons
Gold Coast, Accra	76,022
Brazil	46,260
Ecuador	32,834
San Thomé	29,598
Santo Domingo, Samana	23,389
Trinidad	21,808
Venezuela	12,250
Grenada	7,363
Jamaica	3,405
Haiti	2,028
All other Countries	28,343
Total	283,300

The most remarkable shift in the cocoa trade during the war, is the increase in direct importations from British West Africa from 7,895 pounds in 1914 to 40,424,917 pounds in 1917. These importations, no doubt, included large quantities from Portuguese West Africa shipped via the British possessions.

KOLA

The kola (*Cola acuminata*) is a large, wide-spreading tree resembling the chestnut, indigenous to several parts of Africa. The fruit or seeds of this tree, known as kola nuts, have only within recent years become important in world commerce, but they have long been used by native African tribes, who chew them for their stimulating effect, and declare that they allay both thirst and hunger.

"To the African", says Monteuil, "the kola nut is as **Uses.** indispensable as betel to the Hindoo, as opium to the Chinaman, as cigarettes to the Spaniard, or as the dog to the blind man."

Kola is commonly used as a masticatory to relieve the fatigue of long journeys. A particular advantage in carrying it is that it can be transported in very small compass.

Substitutes. The most important substitute is "false", "male", or "bitter" kola (*Garcinia kola*), also of African origin. This product is from the fruit of the plant instead of from the seed.

The kola tree reaches its full growth about the tenth year, when it yields from 90 to 100 pounds of nuts, and a tree of good size and bearing is estimated to yield about \$10 or \$12 a year. The dark green pods, which grow in clusters, contain from five to six to a dozen seeds or nuts. These nuts are heavy, hard and tough, the surface light brown and minutely granular; they have no odor but are bitter and have a slightly astringent taste.

Preparations. Fresh kernels are preserved entire. Dried kernels are separated in halves or quarters, which are dried and put up for use. The most popular form of commerce is the ground powder, which is freely soluble in water, alcohol and acetone, sparingly soluble in ether, but insoluble in chloroform and benzin. Protocatechuic acid is made from the powder by boiling it with dilute acids.

Production by Countries. Kola trees exist wild or cultivated throughout tropical Africa, but most of the supply is obtained from the Congo, Guinea, Nigeria, Liberia, Dahomey.

It grows in greatest perfection in the hinterland of Gold Coast and is an article of great commercial importance throughout the Soudan.

In the **Congo** it is cultivated chiefly by the natives of the lower river, but the tree is abundant through the whole central region.

In all the colonies of **French West Africa** the kola tree is indigenous, and in all the colonies the negroes consume great quantities of kola nuts.

The production in Guinea is insufficient for local use, but the Beyla district contains 45,000 kola trees, while Rio Pongo has 90,000 trees.

In **Senegal** the negroes are very fond of this nut and consume great quantities. It was once used in this colony in the manufacture of tonics, but this industry has dwindled. The exportation from Senegal, though not large, has steadily increased for 75 years.

In 1897 Dakar exported 2,052 pounds.

In **Nigeria**, the kola nut has recently grown in importance as an export. In this country kola takes the place of tea in all social affairs. In Southern Nigeria, the trees are cultivated in plantations by the Yorubas, Ibos and Binis, but they are seldom seen in Northern Nigeria.

In **Sierra Leone**, the kola nut comes second in importance of products, the oil-palm having first place.

Enormous quantities of these nuts are exported yearly to Gambia and Senegal ports, but they are not largely exported across seas, as natives all along the coast buy most of the supply that comes from Sierra Leone.

In 1912, Sierra Leone exported kola nuts to the value of \$1,345,595; in 1913, to the value of \$1,596,063; in 1914, to the value of \$1,358,582; in 1915, to the amount of 2,484 tons, valued at \$1,500,000.

Sierra Leone exported, 1920, kola nuts valued at £626,-815 (2,657 tons).

The **Gold Coast**, while not producing such quantities of kola nuts as Sierra Leone, yet has a large area in cultivation of the trees, besides thousands of wild native trees which are visited regularly by the natives for their valued production. There are good prospects of this country being one of the foremost of kola nut producers.

The Gold Coast exported: In 1915, kola nuts to the value of \$677,167; in 1916, to the value of \$652,000; in 1917, to the value of \$98,200.

Gold Coast exported, 1920, kola nuts valued at £452,245.

The increasing use of Coca-Kola as a refreshing Outlook. beverage throughout the civilized world bids fair to make this a profitable industry in Africa particularly on account of general discontinuance of alcoholic drinks. Big orchards would yield a good revenue in all the colonies of West Africa.

PEANUTS, ARACHIDES, GROUNDNUTS

The origin of the peanut (*Arachis hypogaea*) is attributed both to South America and Africa. Peanuts have thrived many years in Africa and have become a favorite with the natives, who eat them in great quantities. Of the world's annual harvest of a million tons, Africa produces one-eighth. Export is mostly from the French West Coast colonies. Peanut oil and butter, in addition to food uses, are substitutes for olive oil, and are used in manufacture of soap and perfumes. The residue of plants and shells make fertilizers and cattle food.

By cold expression, as high as 50 per cent. of oil is obtained; by heat a larger, but inferior product.

French colonies usually export in shells. Marseilles lists 10 varieties of peanuts from as many countries; exported mainly after shelling.

French West Africa's peanut trade amounts to 12 to 15 million dollars annually.

Senegal is chief producer. Of the French export of 533,698,023 pounds (\$11,559,067) in 1915, Senegal received \$10,865,700.

Senegal uses primitive methods, scratching the land with an old sword, "hilaire", and getting two tons to a hectare. A plow would triple the yield. Better railroad facilities are needed everywhere.

Senegal exported, 1920, peanuts to the value of 236,719,- 955 francs.

Soudan and Congo export arachides. The crop in Upper Congo runs from 26 to 53 hundred quarts to the acre, worth in Europe, \$60 per ton. Belgium in 1907 imported 1,110,934 pounds (\$80,800).

Rhodesia furnishes peanuts for the Salisbury soap manufacturers.

Some 1500 acres are in peanuts, but the industry is in the experimental stage.

Nigeria's export in 1913 was valued at \$849,993; in 1916, \$2,304,795.

Nyassaland, like all East Africa, employs the natives' crude methods, with good results. Export in 1916 had a value of \$8,000.

German East Africa in 1911 exported 5,523,659 pounds of peanuts (\$116,558); in 1912, 13,400,254 pounds (\$302,- 990).

Mozambique in 1912 exported a value of \$458,423; in 1914, \$253,666.

Madagascar cultivates in interior towns, some 18,000 acres.

Gambia's peanut crop is chief source of prosperity. Export in 1915 was \$1,948,517; in 1916, \$2,530,000.

The British on both coasts have promise of larger exportation.

GROUND-NUTS

Peanuts are often erroneously called ground-nuts, because the matured nuts or seeds are obtained from the ground. There is a real ground-nut, or earth nut (*Bunium esculentum*), belonging to a genus of tuberous plants with edible roots (*Panax trifolium*), and native of Africa. The tubers of this plant resemble miniature potatoes and, being edible, the ground-nut has been extensively cultivated in tropical Africa, where it constitutes a large item of the native diet.

Specimens of these plants have been examined by the Imperial Institute, and pronounced worthy of more commercial notice.

In Nigeria and Zanzibar ground-nuts are grown in abundance, and make excellent food for humans and domestic animals, but they have never become important commercially nor been exported to a great extent.

Gambia exported, 1920, ground nuts to the value of £2,-398,444.

NUTS

Nuts are hard-shelled dry fruit or seeds, having separable shells, which inclose an interior kernel or "meat", of excellent food value. Nuts are of an infinite variety, growing mostly in tropical and semi-tropical countries. Africa has an abundance of nut-bearing plants. Among these are:

The almond tree (*Prunus amygdalus*), a native of Syria, Persia and Algeria, is largely cultivated in all Mediterranean countries, notably Spain, Italy, Morocco, for the kernels of its seeds, which are the popular almonds of commerce. The almond tree grows to a height of about 20 feet; has leaves similar to the peach but its blossoms are much larger than peach blossoms. The fruit is valuable only for its seeds, which may be classed as the most popular of all small nuts, in Africa.

Morocco's export before the war of \$1,523,000 fell to \$842,359 in 1915; \$837,500 in 1916. The Canaries increased from \$21,000 in 1915, to \$29,000 in 1916.

Morocco exported, 1920, almonds to the value of 14,946,-442 francs.

Hazel nuts (*Corylus avellana*) grow well in all temperate countries of Africa.

Brazil nuts (*Bertholletia excelsa*) have been introduced into Africa where they have become a favorite of the natives and are raised for trade also.

Walnuts (*Juglans regia*) are native of Persia and China, whence they spread to temperate Europe, where they have been raised since antiquity, and were later introduced into northern African countries. While not so flourishing as some of the other north African nuts, they have a better place in the southern colonies, where they are grown for nuts and timber. The butter nut of North America (*Juglans cinerea*) has been introduced into South Africa.

Other North American nuts introduced into Africa are the hickory nut (*Carya alba* and *C. nigra*) closely allied to the walnut; the peanut (*Carya glabra*); and pecan (*Carya olivae-formis*).

The pistachio (*Pistacia vera*) is a small spreading tree 20 to 35 feet. When grown from the seed the tree does not bear fruit for six or eight years, but budded or grafted begins to bear in two or three years. It is a native to Syria and Persia, where it is cultivated, as in all Mediterranean countries of Europe and Africa. It succeeds best in Tunis and Sicily, which are frost-free, with sandy soil. The fruit of this tree is a drupe, valued chiefly for the kernel of its seed, which has a delicate flavor. The fruit is picked at maturity and spread in the shade to dry, after which the kernels are removed for export. The annual yield per tree is as high as 60 pounds.

Two other nuts said to have promising value in African tropical countries, perhaps chiefly for their oil, are N'gore nuts (*Ongokea Gore*), and N'kamka nuts (*Heisteria*).

Numerous nuts not yet made commodities of trade, are to be found in tropical Africa.

Strephonema kernels are found in the Belgian Congo, and contain enough fat to make them of considerable value, if they are raised extensively.

The cashew nut (*Anacardium occidentale*) is growing in popularity. This nut is native to Latin America, but is now found in all tropical countries. It grows plentifully and profitably in West and East Africa, Madagascar and other islands.

The wild tree has irregular and spreading branches, but when cultivated its growth is more upright. It attains 16 to 30 or 40 feet; grows best in sandy soil and withstands drought, but in dry countries its productions are increased by irrigation. It bears when three or four years old but not abundantly until eight or 10 years old. It has small rose-colored aromatic blossoms. The kernel which constitutes about 30 per cent of the nut, is covered with a thin yellowish or greenish grey skin; the flesh is a clear white. The kernels have a bland taste; they are eaten in the countries where the tree grows and esteemed as a dessert in Europe. They are used after roasting, as a constituent of nut chocolate, and have other applications, similar to those of the almond, in confectionery.

The cashew "apple" is succulent, and is eaten as a fruit, either raw or cooked, in the countries where it occurs; it can also be made into a preserve. In Brazil, Portuguese East Africa and some other countries, a wine is prepared from the juice by fermentation, and a spirit is obtained from the wine by distillation. Both the wine and the "apple" itself are considered to have antiscorbutic properties. The juice of the rind is serviceable in keeping away ants and destructive insects.

Cashew nuts are shipped in considerable quantities from Portuguese East Africa to Europe. Only the kernels are shipped as the oily properties of the shells make them objectionable. In years that almonds are scarce the cashew nuts are in greatest demand and bring the largest prices. They are usually shipped in cases containing two hundredweight. In 1916 the prices of kernels were quoted at 55s. to 65s. per hundredweight.

In 1914, Mozambique exported cashew nuts to the value of \$9,285; in 1916 1,148,626 pounds to the value of \$6,000.

FRUITS

Africa is pre-eminently the land of fruits. Probably every known variety can be found within its limits. Many fruits are indigenous. Portuguese and Spaniards brought several varieties from South America to the West Coast. Chinese and Hindus have introduced fruits native to Asia on the East Coast. Turks and Arabs have brought fruits from the Caucasus regions into northern Africa. English, French and Germans have introduced favorite fruits into their African colonies.

The Dominions Royal Commission, Third Interim Report, London, 1914, says:

"Many parts of the provinces within the Union of both Africas afford admirable opportunities for the establishment of fruit farming on a considerable scale. Soil and climate alike are suitable, while growers have a great advantage in that their first shipments of fruit can reach the London market two or three weeks before those of growers in other parts of the southern hemisphere. The industry has already assumed large proportions and is giving good returns. It is being fos-

tered by the clauses in the mail contract, which provide for a special rate of freight and facilities for cold storage, with additional concessions if soft fruit and citrus fruit are passed by the Government inspector before shipment.

South Africa exports many peaches and other orchard and stone fruits. One of the most thriving fruits is the plum. Oranges, tamarinds and other citrus fruits are extensively raised and have become a considerable article of export."

"Three hundred tons of South African fruit were landed in Covent Gardens in April, 1919, as an experiment," according to the **South African** of April 19, 1919, and this paper adds: "The fruit consisted of pears, apples and melons. The pears were in an unsatisfactory condition, having been carried on deck, but the apples and melons were in better condition, being hardier fruit."

In 1916, South Africa exported 1,406,958 pounds dried and preserved fruit, valued at \$133,547, and fresh fruit, valued at \$325,262.

In 1917, South Africa exported 2,631,517 pounds dried and preserved fruit, valued at \$239,728, and fresh fruit, valued at \$120,903.

Madagascar is rich in fruit, both native and adopted. In the southern part fruits of the temperate zone thrive, and on to its northernmost shores range fruits suited to warm latitudes. Pineapples have increased in importance as an export, and bananas also do well. Citrus fruits grow in a wild state. Oranges and mandarins are grown in small quantities from planted trees. Semi-tropical fruits, such as mangoes, figs, in small quantities, papayas, pomegranates, also grow in Madagascar, but not in a cultivated state, except at the experiment stations.

Missionaries report that the African natives interpret the Scriptural injunction for man to eat bread by the sweat of his brow, to mean that man should eat until he sweats.

The **Canary Islands** supply a large portion of the European markets with bananas, 2,500,000 bunches being the average annual export, which go to many markets of the world. Guavas, custard apples, and prickly pears are also grown in great quantities, and pineapples thrive; but in these islands, where drought is so common and agricultural products of all

kinds are chiefly raised by irrigation, the banana is the crop most to be depended upon. This industry will probably soon gain its former remunerative pre-war basis.

In 1913, the Canary Islands exported bananas to the value of \$6,628,057; in 1916, to the value of \$2,765,000.

The **Cape Verde Islands** also raise great quantities of bananas, as well as other fruits.

In the islands of **Réunion** and **Mauritius**, a delicious mandarin orange grows to perfection.

Of orchard fruits the **apple** (*Pyrus malus*) is native to most of the cooler countries in the northern hemisphere. Most African countries are too warm for apples to flourish, but in the southern part of the continent there are very promising orchards.

The **pear** (*Pyrus communis*) is grown successfully in northern Africa and in Cape Colony, where it is a favorite for canning.

The **quince** (*Pyrus cydonia*) is a native of Southern Europe and Algeria.

Of stone fruits, the **plum** (*Prunus domestica*) is a native of Caucasus and Asia Minor. Dried plums produce prunes, which support a considerable industry in the uplands of South Africa.

The **apricot** (*Prunus armeniaca*) is supposed to be native of Armenia, but was naturalized in Egypt in very early times. It has spread to many other African countries, and has become a favorite in Southern Africa.

The **peach** (*Prunus persica*) is believed to be native of China, where it was cultivated from remote time. Peach stones were carried by the old trade route to Persia about 300 B. C., and thence to Asia Minor, Europe and Africa. All varieties are grown on the Mediterranean littoral and in the Union of South Africa.

The **cherry** (*Prunus avium* and *Prunus cerasus*), native to Europe and parts of Asia, is sparse in Africa.

The **red** (*Ribes rubrum*) and **black currant** (*Ribes nigrum*) are not yet important fruits of Africa, but grow well in the southern extremity.

The **gooseberry** (*Ribes grossularia*) is grown in small quantities by Englishmen in South Africa.

The raspberry (*Rubus idaeus*) and the blackberry (*Rubus fruticosus*) have been introduced from Europe in northern and southern extremities of Africa.

The strawberry (*Fragaria virginiana*) gives promise in African countries.

The mulberry (*Morus Nigra*) is of very ancient origin and was formerly more popular than now though it is still used for food in many countries, and has been propagated in Tunis, Tripoli and South Africa for silk worms.

The great family of citrous fruits thrive in Africa. The most common of these, the orange (*Citrus aurantium*), is thought to be native of China. There are many varieties, as the blood orange, St. Michael's orange, sweet-skinned orange, called Pomme d'Adam in France; Seville or bitter orange (*Citrus aurantium* var. *Bigaradia*), introduced into Asia by Arabs from India in the 9th century, and from Arabia to England and Northern Africa; bergamot orange (*Citrus aurantium* var. *Bergamia*), of which the rind is sweet and used for essence and sweetmeats; mandarin, or Maltese orange (*C. nobilis*), native of China, from which country it has spread to the Azores and Africa.

The lemon (*Citrus medica* var. *limonum*) is native of India or China, and has been cultivated from remote time in both countries, whence it has spread to Europe, Africa and other countries.

Citron (*Citrus medica* var. *Aurantiaceæ*) is supposed to have originated in Assyria and Media. It was early introduced into Greece and other southern parts of Europe, and northern Africa.

The lime (*Citrus medica* var. *acida*) is native of the warm valleys of the Himalaya mountains, and its cultivation is a great industry in many hot countries, notably the West Indies and African islands.

There is an edible sweet lime (*C. medica* var. *limetta*), which is a native of Southern India and grows well in warm African countries.

The shaddock (*Citrus decumana*), indigenous to the Malay Archipelago, is the largest species of the citrus fruits, sometimes weighing from 10 to 20 pounds. Grape-fruit has become almost as popular as the orange and is found in various parts of Africa.

The banana (*Musa cavendishi*), originally discovered in China, is a main staple among African natives of the tropic belt where nature supplies food in abundance.

In the Congo, bananas are raised with great rapidity and safety; from 6,000 to 8,000 bunches weighing from 60 to 80 tons, may be produced per acre. The principal fruits of the Congo are the banana, pawpaw, mango, orange, lemon, sour-sop, avocado pear, tamarind, pomegranate, guava, pine-apple, bread fruit, and others.

The Belgian Congo exports great quantities of fresh, canned and preserved fruit. In the first half of 1918 this country exported 45 tons of preserved fruits.

The Cameroons can produce bananas abundantly and have sent large exports of both fresh and dried bananas.

The fig (*Ficus farica*) is a deciduous tree said to be native to Asia Minor. The tree grows luxuriantly in northern African countries.

The pineapple (*Ananas sativus*) is native to Brazil. The principal pineapple producing regions of Africa are the Canary Islands, Sierra Leone, Natal and Mozambique.

Among other fruits of Africa may be mentioned the mango (*Mangifera indica*) said to have originated in India but long cultivated throughout the tropical and semi-tropical world; the avocado pear (*Persea gratissima*), a native of South America; the guava (*Psidium guajava*), a seedy tropical fruit of peculiar flavor, but much esteemed for excellent jelly, preserves and a dark rich "paste" much in favor where the fruit is known.

Besides so many temperate zone fruits Algeria is successful in production of citrus fruits also, though exports in this line have not become so important as orchard, stone and small fruits. In 1913 there was a harvest of 250,000 quintals of oranges, and both lemons and limes are grown.

In 1913, Algeria exported to France 385,613 quintals of table fruits to the value of \$3,052,000; in 1915, 36,109 metric tons of fresh fruit, valued at \$1,830,000 and 11,099 metric tons of dried fruit, valued at \$986,600; in 1916, 33,712 metric tons of fresh fruit, valued at \$1,826,938 and 12,712 metric tons of dried fruit, valued at \$1,119,000.

Tunis produces many fruits which bulk large in her exports, both temperate and semi-tropical fruits being successfully raised.

Morocco exports many grapes and other fruits.

Egypt produces fruits in all her fertile lands of the Nile, and in the oases of upper Egypt there is a distinctive variety of plum, the musch, with sweet kernels. Both the dried fruit and the kernels form important articles of export.

German East Africa has nearly all the tropical fruits that grow, and many of them have been cultivated to a considerable degree. Promise of this industry is very great. Germany has experimented much with tropical fruits, and had perfected a process of drying banana pulp that was palatable and keepable.

In British West Africa the lime tree is to be found in nearly every part, and in some places has become naturalized. At present they are raised chiefly for the juice used locally, but both fruit and juice are exported to the United Kingdom in limited quantity. In 1913, 200 gallons of lime juice were shipped from Sierra Leone. British West Africa also produces many other tropical fruits. The pineapple export from Bathurst has grown to large proportions.

In Nigeria limes do so well that there is great promise of an extensive trade in distilled oil of lime and citrate of lime, and of the juice and fruit itself.

Many parts of Rhodesia are admirably suited for the production of oranges. The orange is the fruit which is likely to be most profitable, as it is eminently suitable for export in quantity and ripens at a season just in time to get to the London market when there is a large demand for it. Considerable success is likely to be achieved with the early apricots, peaches and plums. In 1915, the Cape produced over 500 tons of dried apricots, which were quite as good as any produced in California; the demand is still greater than the supply.

In Southern Rhodesia, at the close of the year 1917 there were 149,429 citrus trees in orchards of all varieties, of which about 54,083 were bearing.

Mozambique has become a great fruit market. Oranges are shipped to Europe, but only in small quantities as yet. But many kinds of fruits go through the Mozambique ports and the quantity increases yearly.

In 1916, Mozambique exported 188,788 pounds of fruit through Lourenco Marques, valued at about \$9,000.

In the Union of South Africa, a great part of the exports go to England, but there are shipments to other countries as well. Fruit shipments increased from less than 25,000 boxes in 1905 to more than 200,000 boxes in 1910, and introduction of modern methods has made growth even more noticeable since 1910.

South Africa can grow as fine apricots, peaches and plums as any country in the world. Three thousand hundred-weight of oranges are shipped to England annually from South Africa.

Few products give more promise in African countries than fruit. Many fruits are indigenous to the different regions, and many others that have been introduced thrive as if in their native soil.

As fruit is one of the most widely and abundantly consumed of all food products, it is possible for Africa to be one of the greatest, if not the greatest fruit continent on earth; and modern cold-storage facilities of railroads and steamers make it possible for all kinds of fruit to be shipped great distances with more surety of deliverance than ever before.

DATES

Dates are from the palm (*Phoenix dactylifera*), which is indigenous to the dry hot regions of Northern Africa, where it is also abundantly cultivated, and constitutes the chief food of a large proportion of native inhabitants as well as of their domestic animals.

The best dates come from Algeria and Tunis, but many other African countries produce this fruit in abundance.

The principal cultivation of dates, olives and figs is in the hands of the natives; in Tuat-Oasen alone there are about eight million date palms, which yield each year about three million hundredweight. The date palm in its eighth year gives half a crop, from 15 to 20 years a whole crop.

In 1913, Algeria exported dates to the value of \$920,-417; in 1914, to the value of \$388,316.

In 1916, Tunis exported 7,533,066 pounds of dates, valued at \$287,000; in 1917, 4,273,811 pounds of dates, valued at \$162,000.

In 1916, 2,138,598 date palms were counted in Tunis.

Tunis produced, 1920, dates to the amount of 87,520,-000 lbs.

In the **Soudan** the local demand for the fruit is very large, but there is still enough for exports, which go chiefly to Egypt. The total annual exports amount to about 3,000 tons, valued at \$174,000. Soft dates brought from Algeria have improved the dry date, making it softer and of better flavor. Dates are subject to great fluctuations in price.

WINES AND LIQUORS

Growing grapes for wine is an industry that requires large capital and a considerable period of time without profit or dividend, and consequently has not established itself extensively in Africa. From a commercial point of view, the industry is important in several African countries, but Algeria is the special wine-producing country of this continent and ranks fourth in world production.

In 1914 France produced 1,331,000,000 gallons; Italy, 840,000,000 gallons; Spain, 418,000,000 gallons; Algeria, 267,000,000 gallons; Tunis (1916) 9,914,000 gallons.

Phylloxera and other plant diseases do considerable damage to the vines, and the late siroccos often reduce the output. Lack of labor and shortage of barrels and bottles seriously affected the output during the war.

The year 1914 may be taken as a banner year, with the following total output of 267,485,500 gallons, divided as follows:

Algeria	172,587,141	gallons
Oran	67,454,265	"
Constantine	27,423,195	"
South Territories	20,949	"

The vine-growing in Algeria and Tunis is confined to the strip of land known as the Tell bordering the Mediterranean. About 80,000 quintals of grapes are exported from Algeria each year, and some raisins, though Morocco is a more promising field for the latter, having a better supply of water.

Tunis, 1920, produced 10,952,276 gallons of wine.

In 1901, 150,000 hectares were under cultivation by Europeans in Algeria. In the year 1898, 16,800 Europeans and 11,700 natives were engaged in this cultivation.

Since the Koran forbids the use of wine, only the grapes have been eaten by the Moors.

Algerian wine is generally heavy, has 10 to 14 per cent. alcohol, but little bouquet, since the grapes ripen and ferment too quickly. It is exported principally to Bordeaux where it is prized as table wine. These vines grow best about 500 meters above sea level, and in good localities in fruitful years 80 to 100 hl. per hectare are produced. The white wine is generally better than the red.

During the war one-third of the wine-crop of Algeria was requisitioned for military purposes.

Mistelles is a product peculiar to Algeria. It is a mixture of must and alcohol. The average export is 15,750,000 quarts.

Chasselas de Fontainebleau is a particularly favorite wine of the Algerian coast.

The exportation of table grapes from Algeria is about 4,400,000 pounds.

In 1913, of Algeria's production of wine 142,905,210 gallons went to France (including mistelles), to the value of \$29,-481,908, and 588,472 gallons of brandy and spirits to the value of \$487,200.

In Algeria the yield of wine, 1920, was 157,136,452 gallons.

Wine was introduced in South Africa by the Dutch Colonists as early as 1653, and was patronized by the government. The Hermitage, a claret type, and Drakenstein, a hock type, are two popular wines for export. A good deal of brandy is distilled. The wine industry is almost exclusively confined to the Cape Province, where there are upwards of 4,000 wine farmers. The annual value of the output is estimated at £250,000 and the value of the wine converted into brandy and spirits at £208,000. The export of Cape wines

amounts to little more than £13,000 per annum. The census figures of 1904 showed a total production of over 5,000,000 gallons. In 1911, the amount had increased to 7,500,000 gallons, practically the whole of which, in the form of either wine or spirits, finds a ready sale in the country.

Vineyards were started by expatriated French Huguenots on the tablelands of South Africa, where claret, sauterne, sherry and burgundy are produced. These vineyards have undergone many vicissitudes through insect pests and the fluctuations of the European markets for wine, but at present are gradually expanding.

In 1911, the total grape crop of the **Union of South Africa** was 5,754,000 bushel baskets. From this was made 621,500 gallons of brandy and 5,468 gallons of wine.

In 1916, **Union of South Africa** exported 765,805 gallons potable spirits, valued at \$892,740, and 186,242 gallons of wine, valued at \$209,693.

In 1917, **Union of South Africa** exported 147,305 gallons of potable spirits, valued at \$334,722, and 346,676 gallons of wine, valued at \$252,664.

The value of the wine output, 1920, from **Union of South Africa** was £204,649.

In 1914, **Senegal** exported 154,516 liters of wine, valued at \$18,500.

Mozambique exported in 1915, wine to the value of \$711,981.

Réunion produces 1,100,000 gallons of rum annually.

In 1915, **Mauritius** exported rum to the value of \$31,331.

Canary wine, for more than a hundred years a staple for high livers, is rapidly dwindling. Its first set back occurred in 1853, when disease attacked the grapes. Now, however, under the steady advance of prohibition, the Canaries have replaced wine, first by cochineal, but of late years more especially by sugar-cane.

Other fermented and alcoholic liquors have a place in African commerce also, but in this continent as well as others, the detriment to human beings brought about by intoxicating liquors is receiving attention. Liquors are on the downward trend in Africa.

Scarcity of animal energy and the risk of gasoline have promoted the use of industrial alcohol as a source of power in many regions.

A new fluid, originating in Natal, and known as Natalite, is being introduced as a substitute for gasoline in operating motor cars.

GARDEN VEGETABLES

Human beings can easily subsist without meat; they can not subsist without vegetables, and even the lowest savages are found to cultivate a few plants for food.

Genera and Specimens. Prominent among vegetables stands the white or Irish potato (*Solanum tuberosum*). This tuberous plant is native to the American continents. Potatoes were originally sub-tropical and will not stand much frost. From the Mediterranean to the Cape the potato has become a popular and thriving vegetable of Africa. The Shiré plateau of East Africa, Rhodesia and Cape Colony produce many potatoes.

In British East Africa Irish potato growing was started a few years ago and proved so successful that the supply soon exceeded the demand, because the demand was practically limited to the white people.

The increasing potato crop of Morocco has reduced the acreage of the Canary Islands.

Potatoes are successfully grown in the northern part of German West Africa.

In The Union of South Africa potatoes and all other vegetables have become important in industry. In 1916, South Africa shipped vegetables to the value of \$195,804, and in 1917, to the value of \$298,040. During 1917, 2,000 tons of potatoes alone went to England.

Common vegetables of Europe which are cultivated in limited quantities in Africa include, the **carrot** (*daucus carota*); the **parsnip** (*pastinaca sativa*); the **beet** (*beta vulgaris*); **parsley** (*petroselinum*). Parsley is a native of Sardinia. The **artichoke** (*helianthus tuberosus*), a tuber of a sunflower, is quite popular in several African countries for food.

The **cabbage family** (*brassica oleracea*); **cauliflower** (*brassica oleracea botrytis cauliflora*), and the **turnip** (*brassica rapa depressa*).

The **onion** (*Allium cepa*) is cultivated throughout the length and breadth of Africa, wherever it will grow.

Asparagus (*Asparagus officinalis*) is cultivated in African Mediterranean countries, from which it has found its way to the southern countries and islands.

Chillies (*Capsicum frutescens*), or small peppers, are widely cultivated in the warm countries of Africa, particularly at Zanzibar and Guinea.

The **cucumber** (*Cucumis sativus*) is a native of Egypt, where it has been cultivated for over 3,000 years. It has been introduced into other countries all over the world, growing best in sub-tropical climates. **Vegetable marrow** (*Cucurbita ovifera*) is closely allied to the cucumber. Other popular esculents belonging to the cucumber family as well, are **watermelon** (*Citrullus*); **pumpkin** (*Cucurbita pepo*); **squash** (*Cucurbita maxima*); **bottle-gourd** (*Cucurbita legenaria*), all found in Africa.

The **tomato** (*Lycopersicum esculentum*) is native to America.

The **sweet potato** (*Ipomoea batatas*) and **yam** (*Dioscorea*) largely take the place of white potatoes in various countries. Sweet potatoes are thickened roots of the vine, *Ipomoea batatas*, improved by cultivation. The sweet potato is popular in African countries, where it has been used by the natives so long that they claim it was the first food of man. Sixty thousand hectares of sweet potatoes are planted in **Madagascar** with an average production of 240,000 tons per year.

Sweet potatoes, yam and manioc are the most extensively cultivated plants in the Congo.

Algeria, that formerly devoted large acreage to cotton, has of recent years taken to early garden vegetables, so that the country has become the veritable kitchen garden of the mother country. Certain vegetables which are highly esteemed in France, as artichokes, tomatoes, potatoes, green peas and beans, form a large item of the exports.

In 1907, Algeria exported garden vegetables to the value of \$1,850,000. The product and varying export through the years culminated in 1917 with 27,000 acres in potatoes (2,756,000 bushels).

In the first half of 1918, **Belgian Congo** exported 75 tons of preserved vegetables and 20 tons of potatoes and onions.

The indigenous yam is cultivated in Dahomey and the Ivory Coast especially. The Baoules of Ivory Coast feed themselves exclusively on igname, bananas, a little rice, manioc and corn.

The natives in Southwest Africa cultivate Irish potatoes, tomatoes, sorrel, onions, garlic, pepper.

In Egypt and other North African countries, garden vegetables form a very important item in the yearly yield. In 1915, Egypt exported onions to the value of \$1,740,483, and in 1916, to the value of \$1,551,206.

In Senegal, the native is the only farmer, and his methods are very crude; he does not plow the land, on account of superstition. As it takes white settlers a long while to persuade the blacks to overcome superstitions, agriculture in Senegal is growing slowly.

Mozambique, besides furnishing her own population with potatoes, has been able to export small quantities. In 1916, this country exported through Lourenco Marques, 90,343 lbs. of potatoes, valued at about \$600.

Vegetables grow well in all of the African islands, the Canaries especially giving attention to this form of agriculture. Tomatoes do exceptionally well in these islands, an acre yielding about 20,000 pounds of fruit.

Bananas, tomatoes and potatoes are grown under irrigation and the yield varies little from year to year.

Onion seed is the Canarian product most interesting to the United States, as almost its whole supply is raised in the two islands of Teneriffe and Gomera. There are only six firms engaged in the business. They engage small farmers to grow seed from selected onions. In 1914, the Canaries exported onions to the value of \$123,644, and onion seeds to the value of \$43,000. In 1916, the Canaries' onion crop amounted to \$164,000; tomato crop, \$415,000; potato crop, \$421,000.

The tomato crop of the Canaries in 1913 amounted to \$2,477,654, and the potato crop to \$276,578; and in 1914, the tomato crop amounted to \$2,315,306, while the potato crop amounted to \$528,777.

WOODS OF AFRICA

The area of forests in Africa is comparatively small. Jungles of giant grasses cover vast stretches of this continent. In the north is the great Desert of Sahara, where sand has accumulated for ages and is still continuing to encroach upon the forests to the southward. How to stop the desert's spread is a challenge to man's scientific mastery of nature.

'Uses and By-Products. Woods are soft or hard, those of quick growth usually constituting the soft woods, and those of long, slow growth the hard woods. After the trees become lumber the wood is classified according to color, hardness, weight, strength, elasticity, grain and durability.

The important commercial woods of Africa are: Mahogany, cork, okumé, ebony, rosewood and brier.

From various waste woods are obtained acetic acid, which is largely used in producing crepes, rubber, creosote, potash, tar, acetate of lime, methyl alcohol and charcoal.

In Egypt, utilization of the woody cotton-stalks is being experimented with.

Liverpool, London and Glasgow were markets for African mahogany before the war. Hamburg was the great market for heavy mahoganies. From Hamburg the markets of Scandinavia, Russia and Austria were supplied. Shipments were made to the United States from Liverpool, mostly from the Gold Coast.

Prior to the war the United States, out of total importations of mahogany logs of 70,914,000 feet, there were 31,177,000 feet of African stock.

Ivory Coast exported, 1920, Mahogany to value of 20,-370,876 francs.

Of African timber trees, **mahogany (*Swietenia mahogani*)** holds an important place, and thrives throughout Equatorial Africa.

Homer Hoyt of the War Trade Board makes this comment on African mahogany:

The natural range of African Mahogany (*Khaya Senegalensis*) comprises a belt fifteen degrees north of the equator and twenty degrees south extending across the continent of Africa, from the Atlantic to the Indian Ocean. It grows in very open stands and in desert sections is lacking, but the trees,

though scattering, are very large. Logs reaching American ports are often four to five feet, squared. On account of its range and size, the stand of African mahogany is probably greater than the total of all other countries combined.

African wood is usually more handsomely figured than Central American wood, but is of a coarser grain, and varies greatly in quality from the outside to the heart of the log. All of the logs seen by me were defective at the heart and when sawn were usually first split in two by the sawyer on account of their size and also to box out the heartwood to best advantage. A curious defect in African mahogany is a frequent breaking of the wood across the heart and even extending to the outer portions. Although I have not seen reports from the laboratory, the fibre of African mahogany is undoubtedly shorter and the wood considerably more brittle than Central American mahogany.

Although African mahogany is not of the same quality or species as that from Central America and Cuba, it is allowed for airplane stock.

The actual source of a number of mahoganies from West Africa is unknown except to a few merchants who control the output.

African mahogany, on account of its figure and ease of working has been popular in the furniture wood market. Its price is equal to that of true mahogany, and is liked by all except the chair manufacturers. As labor is extremely cheap in Africa the logs do not cost much to produce. The principal item in cost is water freight.

Today the mahogany comes out largely by floating. This makes the production of mahogany logs dependent upon floods. No one can calculate how many logs will eventually reach the salt water where they can be loaded on vessels.

Further up in Nigeria are teak plantations near Odogun and beyond in the uninhabited region, the fringing forests, with the real African mahogany, *Khaya Senegalensis*.

Turning back to the railway and southeastward we find the Ona River forests, part of which are reserved where exist mahogany, rubber and satinwood, a most valuable soft wood.

The evergreen forests near Benin have proved the richest in mahogany of any exploited thus far in Nigeria. On one area of eight square miles over 1,000 large trees were got out in the shape of logs in a few years. The largest mahoganies have been found here, 56 feet in girth; the age of one large tree was found to be 537 years. The variety attaining the largest size here is a "juju" tree.

In Nigeria the *Khaya* mahogany is the most prevalent. Near the Ogba are found African walnuts also.

In the Ibo country, farther east, where the country is much more thickly settled, all but the most inaccessible or water-logged areas have been destroyed. Red ironwood is

the most prevalent in the Imo evergreen forest to the east. An almost unbroken forest of oil palms extends from the Kwa Ibo River to Bende. Here we find also the hard pearwood.

The finest mangrove forests of the whole country are in the lower reaches of the Cross River. Redwood, red ironwood and aligna are found further up. On the right bank of the Cross River beyond the Aiya are in addition to mahogany, the iroko as one of the commonest trees.

Forests. Below the eastward bend of the Cross River are the Oban Hills which, at a height of 3000 feet are covered with trees and where the ebony is still common. The tala, red ironwood, mahogany and aligna are also found here. The natives say it is possible to walk about in this forest for three months and not come out; one path goes all round it, but none go through it.

Important Species of Trees. The Khaya mahogany is the most valuable. The African walnut belongs to this group. There are two varieties which yield scented wood very similar to mahogany for which they can be substituted with the special designation of scented wood. Next in importance is the iroko, or African teak, or rock elm, which takes the place of oak both for European and native use. The ebonies are still found, though most of the best trees have been cut. In spite of the wanton destruction of these trees, considerable amounts exist in the more inaccessible forests, especially near the Cameroons border.

Camwood is found but the best trees have been cut down. Barwood and other species have largely taken its place; camwood is used for dyeing purposes.

Satinwood is another valuable tree.

The shea butter tree is of the greatest value chiefly for the nuts and butter, but for the timber also. This is used in making mortars used in preparing food for cooking. Next in importance to this is the pearwood, one of the giant trees, the most cylindrical, the tallest and straightest of all. The red ironwood's brilliant red leaves, in the autumn, light up the whole forest; at a distance the tree seems to be in flower. One of the most valuable trees locally is the opepe which is very durable and termite proof; easy to work, it is used for weather boards.

In 1913, Nigeria exported mahogany to the value of \$527,000; in 1915, to the value of \$270,000.

Next to mahogany the most important commercial wood of Africa is **cork oak** (*Quercus suber*). This material played a large part in the war, being used for life-preservers, buoys, life-rafts, as a protective filler on backing battle-ship hulls.

Uses of Cork and Substitutes. Cork is used industrially for stoppers for bottles, in making linoleum, insulators, life preservers, covering refrigeration pipes, lining of refrigerators and ice-boxes, for carburetor floats and gaskets in motors, besides the ordinary uses of domestic life.

In the process of manufacture the cork bark loses about 70 per cent in waste, shavings, refuse, etc. Practically all, however, is redeemed in the manufacture of composition cork, so that no more than 5 per cent. of the crude cork is finally lost.

Cork is an odorless, tasteless, resilient, buoyant substance, impregnable to gases and liquids, of low specific gravity (0.215), and a non-conductor of heat, sound and electricity.

Balsa wood, grown principally in Central and South America, is largely used as a substitute for cork.

Military requirements for the United States for cork in 1918, were: Navy, 2,100,000 pounds; Shipping Board, 8,100,-000 pounds.

Besides cork, **Tunis**, in 1915, exported 10,000 tons of lumber, valued at \$95,000. In 1916, Tunis exported 6,016,384 pounds of cork, valued at \$192,000; in 1917, 2,244,644 pounds valued at \$72,000.

In 1913, **Algeria** exported corkwood, valued at \$2,218,-535; in 1914, valued at \$1,670,608; in 1915, 12,191 metric tons of crude cork, valued at \$828,356.

In 1915, Algeria exported 216 metric tons of worked cork, valued at \$135,679; in 1916, 16,226 metric tons cork, valued at \$1,085,046; in 1916, 785 metric tons of worked cork valued at \$492,536; in 1913, 5,707,900 pounds of exotic wood to France, valued at \$219,200.

It is estimated that Algeria has 1,112,000 acres in cork-oak, with an annual average output of 50,000,000 pounds of cork and an annual average export of 34,000,000 pounds; while Tunis has 850,000 acres, according to later report, with

an average annual output of 7,000,000 pounds of cork and an export of 5,000,000 pounds. Morocco also produces considerable cork. The United States is the largest importer of cork —nearly 132,000,000 pounds in 1914 and 168,241,829 pounds in 1917.

In the time of the Romans Tunis had great olive forests. These forests were used principally for their fruit, but olive wood from them, also, was much prized. In the eleventh century the Arabs destroyed nearly all of the trees. Much of this land has now been reclaimed.

French Equatorial Africa exported: Okoume wood, 62,395 tons valued at 2,998,000 francs, against 43,183 tons valued at 2,103,842 francs in 1912; mahogany, 4,552 tons valued at 601,260 francs, instead of 646 tons valued at 109,820 francs in 1912; ebony, 90 tons valued at 18,000 francs; moabi. analogous hard woods, 53 tons, valued at 3,975 francs; coral, 32 tons, valued at 3,720 francs; mandji, 30 tons, valued at 2,100 francs; fine woods, 12 tons, valued at 1,200 francs; walnut, 9 tons, valued at 675 francs.

French Equatorial Africa exports okoume wood into Spain, 500 tons in 1892. Likewise to the United States in 1913, 3,329 tons of okoume valued at 16,800 francs against 27,720 francs in 1912.

Before the opening of hostilities this trade which ranked second in the export movement of the colony and which represented alone a fourth of the general exports, found its most important market in Germany. Eleven thousand tons of mahogany are annually shipped from French Equatorial Africa.

Of all the woods of the **French Congo**, the most important species is the okoume which may be estimated at present at from 60,000 to 70,000 tons annually. Okoume serves for making cigar boxes, in German trade. The wood used thus is estimated at 50,000 tons. The okoume is used also for making furniture whose inside is made of ordinary okoume upon which is placed valuable wood (walnut or mahogany).

Besides okoume wood, the Hamburg trade deals also in the silk cotton tree (**fromager**) which is used for making packing cases and which appears to have given good results in the making of interiors for furniture.

Imports of fromager have notably increased; from 25 tons in 1909, statistics give 525 tons in 1910 and 2,656 tons in 1911; total imports into Germany decreased in 1913 to 44 tons.

Exports from Gaboon to England in 1912: Okoume wood, 26,923 tons, valued at 1,431,140 fr.; mahogany, 4,552 tons, valued at 601,260 fr.; oak, 90 tons; moabi and analogous woods, 53 tons; coral, 32 tons; mandji, 30 tons; fine woods, 12 tons; walnut, 9 tons; miscellaneous woods, 70 tons.

Ebony slightly decreased in 1912; coral slightly increased; mandji sensibly decreased; fromager which figured slightly in the exports of 1912, has completely disappeared from the market.

The baobab or monkey bread tree (*Adansonia digitata*) is an enormous tree of tropical Africa and the East Indies, often growing to a diameter of thirty feet. It bears a gourd-like fruit known as monkey-bread.

The baobad abounds in certain parts of the Congo. In the lower part of the Senegal the baobab tree is found everywhere. The pulp of the fruit is used for food, drink and medicine. Baobab was formerly exported from Senegal. From 1890 to 1892 154,699 pounds were exported.

In Egypt and the Egyptian Soudan, trees are Production by Countries. not numerous, as there is so much desert land, but there are a good many date palms.

- On the plains of the Nile are to be found sycamore and acacia. Farther south, in Soudan, are acacias of several species, and in the southern part of the Soudan are the baobab, borassus palm, and on the higher land toward the Abyssinian tableland, as well as in the foothills of the equatorial plateau, are mixed forests where very good timber is found.

Throughout Equatorial Africa, from the Atlantic to the Indian oceans, are to be found many of the most valuable woods.

In French Equatorial Africa are many species of wood. Everyone of them has utility—as foodstuffs, condiments, fat, drinks, perfumes, aphrodisiacs, pharmacopoeia, arm and experimental poisons, dye, cordage, textile, mats, pirogues, carpenter work, tools, pestles, mortars, various utensils, furniture.

The principal forest riches of the French West African colonies are cabinet woods, gum, palm oils and almonds, copra, textile fibers, karite, colas and rubber. Only the expensive woods have so far been exported, principally mahogany.

In Sanwi the native traders of Assinia serve as agents to the merchants of Liverpool, but the natives refuse to work for the traders. They group themselves into villages and share the forests in common, each chief having his zone of exploitation. When a fine tree is found the road to it is marked and the tree is identified with a charm. Then with the help of his family and friends the finder cuts down the tree and takes it away. It is officially reported that on one occasion the whole population of a village harnessed themselves. The chief paid each man five francs and each woman and child two francs 50, for dragging the log to the river: he employed 100 men and 50 women—575 francs. Transportation had cost about 350 francs. The log brought 210 pounds in Liverpool; net gain, therefore, was 4,325 francs which was shared between the chief and the happy finder.

The Ivory Coast is the only one of these colonies which does not need reforestation.

In 1912, French West Africa exported 67,217,776 pounds mahogany, valued at 559,030. In 1913, 94,030,222 pounds mahogany, valued at \$967,474.

In both the French and Belgian Congo the palm is the principal tree, but there are also mahogany, rosewood and caja.

Numerous forest materials of the Belgian Congo are furnished from the elongo, a yellowish wood; eluku, kabumba, kambaki, nombinxo, a good building wood of yellowish white; makutu, of excellent quality; tjuija.

Nigeria has extensive forests, so dense that the only open spaces are where farms or towns have been cleared. Beyond the mangroves grow lofty forests, including palms of many kinds, hardwoods of various species, mahogany, ebony, teak, redwood, African cedar, plane, silk-cotton, etc. The kuka or baobab stretches over great areas, and giant bamboos, growing 60 and 80 feet high along flood plains of the rivers, resemble forests. Mahogany logs weighing 20 tons were, before the war, hauled to the river beds and floated to ocean steamers.

Nigerian export of mahogany declined from \$512,970 in 1913, to \$240,191 in 1916.

In Southern Nigeria there is probably an area of 40,000 square miles of heavy forest including the mangrove and other swamp forests areas; in addition probably 25,000 square miles of dry zone of orchard forest. Vast areas of mangrove swamp forest are on the banks of the various mouths of the Niger. About ten miles from the bank of this river is the Iwoye forest where mahogany is the most prevalent tree.

Near the coast of Sierra Leone there is the Peninsular forest, about 5,000 acres in extent. Eighty per cent. of the whole "stand" consists of red ironwood.

Besides this, there is an African violet wood, scented mahogany, cedar, iroko, real African oak, pearwood, red oak. Again, further north in this Protectorate, there are large tracts covered with the fan-palm, which bears large fruits. These contain large nuts which are used for making buttons. The wood of the stem has proved most durable.

The colony of the **Gold Coast** includes also the Protectorate of Ashanti, and the northern territories, comprising in all 120,000 square miles in extent. Thus far, most of the timber extraction has been done nearest the mines, such as Taquah and the Ashanti Gold Fields Corporation, both near the railway which runs up from the port of Secondee. In fact, the railway has been the chief means of exploiting some of the forests.

Further west the Ankobra river has been the chief means of transport. Up to the present about 5,000 square miles have been set apart for plantation or timber work. There are, however, between 10,000 and 15,000 square miles of forest not yet placed under systematic working.

Senegal is the ante-chamber of the desert, and every tree, every bush cut brings it nearer to that desert. Yet the Europeans have denuded the region without giving thought to the future.

From 1825 to 1837 inclusive, approximately 258 cubic meters of wood were exported from Senegal.

In 1840 exportation included cabinet woods: Sandalwood, 8,477 kilograms; ebony, 8,002 kilograms; cailcedra, 165 cubic meters. From 1865 to 1877 inclusive, 3,674 steres of wood were exported from Saint Louis for fire wood, and 13,956 steres of charcoal, besides some building wood.

From 1897 to 1899 inclusive, only two steres of fire wood were exported from the whole colony.

St. Louis has no forests anywhere near it—all this wood comes from the river; it is brought either by barges or by pirogues and comes from very far since the woods may be considered as denuded from 300 kilometers all around. If one considers the climatic conditions of Senegal, one may understand how fatal to such a region is a denudation carried out without thought and without care for reproduction. The neighborhood of Dakar is denuded, and the neighborhood of Rufisque may be considered so.

In the **Gold Coast** are to be found mahogany, teak, ebony, camwood, so popular for inlay in furniture, and valued at \$150 per ton, and bombax or silk-cotton, a magnificent tree and one of the most common timber trees of this region. Its soft wood is much used by the natives for their dug-outs.

In 1913, the Gold Coast exported 37,392,100 sup. feet of lumber. In 1917, 1,003 tons of native timber, valued at \$5,000; in 1917, 11,649 tons of fire wood, valued at \$14,000.

Angola has a variety of timber, one of its most conspicuous varieties being the tacula, which grows to immense size and has blood-red wood, valued for manufacture. Mahogany also grows well. In 1898 Angola exported wood to the value of \$11,000.

In **East Africa** acacias and giant euphorbias are found. There are also forests of cotton-trees, sycamores, the spreading banyan, the conspicuously characteristic doum palm and grotesque baobab. Acacias are found everywhere below the altitude of 6,000 feet; and in the upper highlands are found the juniper, cypress, cocoanut, tamarinds and yews, while all along the coastal marshes mangroves grow. Both English and German East Africa, before the war, were wise enough to realize the value of the forests for future use and had laws for protecting and extending them. The use of wood has been chiefly local so far, but the commercial outlook in timber is promising.

In 1911, German East Africa exported 13,569,470 pounds wood and timber, valued at \$122,494; in 1912, 8,464,923 pounds, valued at \$56,099.

Somaliland has vast stretches of jungles or low scrub, with woodland on the crests, containing box, cedar and Somali pine (*Juniperus procera*).

In **Mozambique** the exploitation of timber is an industry which has a great future. Its forests contain numerous hard woods excellent for making furniture, as well as softer timbers valued in house and other construction, and mangrove swamps are numerous all along the coast.

In 1914, Mozambique exported, through Lourenco Marques, mangrove wood to the value of \$185; in 1914, through Chinde, firewood to the value of \$4,320; in 1914, through Mozambique, ebony to the value of \$2,265; in 1914, through Chinde, timber to the value of \$981; in 1916, through Lourenco Marques, 234,997 pounds of timber, valued at \$523; in 1916, through Chinde, 1,180,250 kg. of firewood, valued at 6,480 escudos; in 1916, through Chinde, 172,669 kg. timber, valued at 1,860 escudos.

Madagascar has an enormous forest covering 25,000,000 acres, and much of the wood found in the large areas is hard and suitable for cabinet and carriage making. In 1917, the island exported 6,424,000 pounds of common timber, and 173,800 pounds of ebony for cabinet making.

The **Canary Islands** are rich in timber. Walnut trees, osiers, heather trees, laurel, bracken, scrub pine, broom, mahogany, hard white wood, cork, elm, oak, eucalyptus, plane, beech, cypress, coral tree, stone or umbrella pine, camphor, india rubber tree, wattle, pepper tree, acacia, araucaria and rose apple; also the fir, the mango and the blackberry. A large part of the forests have been burned or destroyed.

Woods excellent for making furniture, as well as softer timbers valued in house and other construction, and mangrove swamps are numerous all along the coast.

In 1914, **Mozambique** exported, through Lourenco Marques, \$185 worth of mangrove wood; \$2,265 of ebony; through Chinde, firewood, \$4,320; timber, \$981.

In 1916 the export through Lourenco Marques was 234,997 pounds of timber valued at \$523; through Chinde, 1,180,250 kg. of firewood, valued at 6,480 escudos, and 172,669 kg. timber, valued at 1,860 escudos.

Mozambique produced in 1913, \$78,840 worth of mangrove bark, of which the United States took \$30,281 worth, and would yearly import the entire produce with ready transportation, as the demands exceed the supply.

In South Africa there are 474,000 square miles, of which 450,000 acres are native woods. About 61,000 acres have been planted with exotic trees, along coasts and mountain sides.

Stinkwood used in cabinet and wagon making, is the most valuable native wood. Yellowwood, used for sleepers, has the tallest trees (630 feet). Sneezewood is durable. Wattle, valuable for its bark, is of growing importance, as mine props, posts, fuel and for distilling. Black iron wood is common, strong and hard. The local boxwood is equal to the turkish for turning, screwing or engraving.

The amount of wood cut during the year 1910-11 was about 14,000,000 cubic feet, and while the export of South African timber does not on the average exceed £5,000 in value each year, the imports of unmanufactured timber during the years 1913 to 1915 averaged about £520,000, representing about 8,500,000 cubic feet, of which the greater proportion was pine, much of it from the United States.

In 1913 the Union Forest Act was passed to conserve and increase the forestry production. On the Cape Peninsula conifers and eucalypti have been planted.

The furniture business has grown rapidly in the Union of South Africa, and excellent work is turned out, although the industry has been handicapped by scarcity of competent labor. Timber seasons slowly in this country; most of the wood used in furniture making is imported.

The calabash tree, from which a gourd serves as a common drinking cup, is abundant in Southern Africa.

In Madagascar the forests contain nearly every variety of wood, and suitable for nearly all the industrial purposes. Madagascar has an enormous forest covering 25,000,000 acres.

In 1917, the island exported 6,424,000 pounds of common timber, and 173,800 pounds of ebony for cabinet making.

Outlook. Much of Africa is in need of re-foresting in order to conserve the valuable native woods. The blighting sands of the Sahara are encroaching upon forest areas. Reclamation of savannahs by drainage, harnessing of the many rivers for driving saw mills—reforesting, are much in need. There is great waste in cutting wood by crude native methods. Everywhere in French Equatorial Africa except on the Ivory Coast there is need of reforestation.

WATTLE AND OTHER TANNING BARKS

Chief among the tanning barks of Africa is wattle, with mangrove a fair second, followed by oak, hemlock, willow. Galls of the oak and sumac, formations on the barks of these trees, are also used in this way.

Procuring, raising and preparing wattle, the bark of various acacia trees (*Acacia longifolia*) is a large African industry. Wattle bark is a tanning material for producing heavy leathers, to which it gives a reddish tinge. The acacia from which wattle is procured is native of Australia and was introduced into South and West Africa within recent years, but a larger amount is now produced in South Africa than in Australia. Black wattle (*Acacia decurrens*) is best known and best quality.

Production and By-Products. The seed is planted in plowed land, and in seven to nine years the trees are ready for cutting, when they have reached a diameter of six or eight inches. Each tree should yield 100 pounds of green bark, and average yield to the acre is three to three and one-half tons of dried bark, while thinning out of trees in the fourth year gives a further yield of three-fourths ton. Five hundred dollars gross return per acre is considered good.

The crude bark is crushed between moist bronze rollers, boiled, purified, hardened and shipped in 100 pound bags.

After the tannin (32 per cent. is the average) is secured, the pulp remaining is made into a coarse paper. Railway ties and mining props, methyl alcohol and 20 kinds of dyes come from wattle. A ton of the wood yields 139 pounds of acetate of lime; 3.7 gallons of wood spirits; 134 pounds tar, 605 pounds charcoal.

The bark contains cellulose up to 60 per cent, $11\frac{1}{2}$ per cent. moisture, and 8.7 per cent. ash.

London is the chief buyer, paying £9 per ton in 1906; £8 during the next five years; £7 in 1912, 1913 and 1914. The war increased the price in 1915 to £13; 1916 and 1917 to £17.

Natal is chief producer, having in 1918, 160,000 acres; Transvaal 20,000, and all South Africa 250,000 acres.

South Africa shipped in 1911, 111,205,265 pounds of wattle bark, valued at \$1,440,000; in 1913, 145,717,738 pounds, valued at \$1,535,000; in 1915, 89,661,464 pounds, valued at \$976,000; in 1917, 100,000,000 pounds, valued at \$1,367,000; in 1917, 2,784,188 pounds wattle bark extract, valued at \$247,200.

This was practically all shipped from Durban, but a small quantity went from Delagoa Bay.

Natal now has a large plant for extracting tannin, is establishing others, and ships it chiefly in that form.

In 1913, Mozambique produced \$78,840 worth of mangrove bark. Of this total, \$30,281 worth went direct to the United States, the total American imports from Portuguese East Africa during the year. The demand for mangrove bark in the United States is constantly increasing and far exceeds the supply.

British East Africa has 12,000,000 acres in wattle and other tanning bark trees, but as yet many of the plantations are young. In 1914 there were 11,000 acres in wattle. The industry is protected by the government. The prospects are very promising.

German East Africa exported tanning barks in 1911, 4,188,998 pounds, valued at \$22,816; 1912, 5,500,403 pounds, valued at \$23,734.

Wattle bark to the value of £986,484 was exported, 1920, from Union of South Africa.

Procuring and preparing wattle is also important in Angola, Mozambique and Madagascar, although none of these countries have yet had shipments of great commercial importance.

MANGROVE

Mangrove (*Rhizophora*) grows on the swampy coasts of all tropical countries and it is especially used in African countries for its bark which is rich in tannin, good bark having

over 30 per cent. of tannin. It is also shipped to tanneries abroad, though not so extensively as wattle. The wood of the mangrove is used for building material and posts.

Portuguese Africa had a very important export trade in mangrove bark in the early part of this century, but about 1908 this fell off because of the reckless destruction of trees. The industry is reviving, however, and conservation will provide for a constant yield.

In **Mozambique** the industry is of comparatively recent introduction. In 1913 this province collected 4,000 tons of mangrove bark.

In 1914, Mozambique exported through Quelimane, mangrove bark to the value of \$6,922; through Mozambique, \$22,080.

The one product which has been exported regularly to the United States from Mozambique is mangrove bark. There were 15,580 tons, valued at \$931,483 invoiced at the American consulate at Lorento Marques, Portuguese East Africa, for the United States during 1916, against 10,836 tons valued at \$489,162, for 1915.

British East Africa has vast mangrove swamps and produces considerable amounts of tanning bark and lumber from them. In 1915-1916, besides quantities of bark, 500,000 borities were exported, chiefly to Arabia.

In **Nigeria, Gambia and Sierra Leone**, mangrove is of commercial importance in all the swampy regions, the bark for tanning purposes being utilized.

Along the whole coast of Rhodesia are mangrove and other trees furnishing tanning bark. They rank in importance, *rhizophora*, *racemosa*, *brugiera gymnorhiza*, and *ceriops candelleana*. Only the first mangrove species has been exploited. In 1907 this output amounted to 111,735 kilograms of bark, valued at 870,000 reis.

In **Angola**, the bark of the *musuembra* is found in large quantities and used for tanning leather.

Tanning Materials of Madagascar.

The only tanning material produced in considerable quantity in Madagascar is red mangrove bark. During the past three or four years production has been

declining, due to the scarcity of mangrove trees and, more recently, to transportation difficulties. The two French navigation companies now serving Madagascar always find sufficient freight of a higher class than bark, and consequently it is difficult to obtain shipping space for the latter.

GUMS AND RESINS

The gums and resins of commerce are formed by the thickening of saps of trees or plants, and are obtained from the excision of plants or are artificially extracted. True gums are soluble in water, in which they form a mucilage. They are used in thickening fabrics, in mucilage, ink, medicines, cordials, confections, stiffening hats, baskets.

Of African gums Copal and Gum Arabic stand foremost. These products, owing to the ruthless, wasteful methods of obtaining the wild supplies, are rapidly diminishing.

Resins are harder than gums and are insoluble in water. They are used chiefly in medicines, varnishes and incense.

Belgian Congo exported, 1920, copal to the value of 40,-305,021 francs (13,249,514 kilos).

Gum copal (Trachylobium) is a resinous substance that exudes from many tropical trees. There is also a fossil copal of the best quality dug from the ground where great forests once existed.

When first dug, fossil copal is covered with a sandy crust, usually of a reddish tint, and in order to remove this it must be scraped or dissolved by a solution of soda or potash. It is usually exported in the rough state and cleaned in the foreign markets. To become soluble in alcohol or turpentine, copal must be melted or distilled.

Gum copal is found in almost unlimited quantities in many parts of Equatorial Africa. In 1912 it could be bought from natives for 2d. per pound, bringing 1s a pound in British markets.

Pitman's "Common Commodities and Industries" states: The principal sources of the copal of commerce are East Africa, West Africa, the Dutch East Indies, certain islands in Polynesia, New Zealand, New Caledonia and the north-eastern portions of South America.

The East African product is collected in British, Portuguese and (the late) German East Africa, and is usually sent thence to Zanzibar, where it is sorted, cleaned and packed for export. It is known as Zanzibar animi or copal, and varies greatly in price, in normal times dust fetching about £30 per ton and fine grades over £300. The value of the exports from Zanzibar reaches about £15,000 per annum. The East African copals are fossil resins. They are probably the product of species of *Trachylobium*.

The West African copals are obtained along the coastal regions of West Africa, from Sierra Leone to the Portuguese Congo. The finer varieties are fossil or semi-fossil. The best varieties are obtained from the Congo, Angola and Benguela; the medium qualities from Sierra Leone and Accra, and the low grades from the Niger Districts. The trees which yield or have yielded these types are probably *Copaifera guibourtiana*, *Cyanothryrsus ogea* and *Daniella oblonga*. They are of far less value than East African copal, the best qualities, in normal times, being worth about £75 per ton.

Production by Countries. Throughout the Congo forests copal trees abound. The gum is used principally for varnish and is of various qualities and varieties.

Before the war practically all of the Congo's large output of gum copal was marketed through brokers in Antwerp. England has become the only market for this article, which is one of the chief products entering into the export trade of the Belgian colony. In 1906 Belgian Congo exported 1,911,217 pounds of gum copal, valued at \$220,000.

In 1911 Belgian Congo exported 4,800,000 pounds of copal; in 1914, 8,910,000 pounds; in 1915, 14,630,000 pounds; in 1916, 15,000,000 pounds.

In Southern Nigeria a good quality of gum copal is collected under the name of ogea gum.

In Senegal copal trees grow in certain sections, but the gathering of the gum is not a very important industry of the country.

In 1915 Senegal exported gums to the value of \$296,-317, a large proportion of which was gum copal.

A considerable amount of gum copal goes to foreign markets through Morocco ports. In 1913, \$118,000 worth was brought in by desert caravans.

In 1913, **Angola** exported 248 tons of copal, valued at \$29,377.

In **Sierra Leone** the export of gum copal was prohibited for five years, by local order of the Council passed September 30, 1913. The gum produced in this country is so hard that it is called "flint copal". On the Massewe Hills Reserve an area of about 350 acres was cleared of undergrowth and planted with copal producing trees.

In 1912, Sierra Leone exported gum copal to value of \$7,820; in 1913, \$13,050; in 1914, \$14,963.

In the **Soudan** copal is gathered by the natives. Women of fantastic tastes produce wonderful coiffures with the aid of this gum.

The copal gum tree is found in **Guinea** and the **Ivory Coast** especially. From 1890-1899 average exportation of gum copal was 3,945,376 kilograms; largest figure was 5,909,-542 kg. in 1898.

In **British East Africa** the commercial output of this gum or resin has been greatly decreased since the war. There is prospect, however, of the gum trade becoming very extensive in this country.

German East Africa abounds in copal forests. In 1911, German East Africa exported 210,021 pounds of gum copal, valued at 25,567 marks; in 1912, 237,795 pounds, valued at 28,493 marks.

Zanzibar once abounded in copal-producing trees, but extension of cultivation of other productions has almost annihilated them. There is much fossil copal in Zanzibar.

In **Madagascar** copal gum is exported to France, where it has brought as high as \$80 for 220 pounds. About 300 tons are exported per annum.

In 1916 **Mozambique** exported 6,395 pounds of gum copal.

Myrrh (*Myrrha commiphora* and *M. balsamea*) is obtained from a shrub of Abyssinia and Arabia, and was a characteristic plant in the time of Herodotus. The substance so named in Bible times is supposed to have been a mixture of myrrh and labdanum.

Myrrh is used in perfume, incense, as a tonic internally, and as a cleansing agent externally. Myrrh gum makes excellent mucilage as it keeps unusually well; and myrrh resin is used in varnishes.

In Somaliland the collecting of myrrh is done under official sanction, by the Somali natives, who obtain the gum partly from natural fissures and partly from artificial incisions made by themselves. The crops are sent to the capital of Somaliland, Berbera, and to Aden in Arabia.

Somaliland produces numerous other gums and resins, which are classed under the name of bdelliums.

Frankincense or Olibanum (*Pinus abies*, *P. balsamea* and *Larix*) is another fragrant gum obtained from small trees or shrubs. Frankincense is obtained in the same localities as myrrh and is similarly produced. Its uses are chiefly in medical plasters, in perfumes, and as incense.

Camphor (*Cinnamomum camphora*), is a large, beautiful evergreen tree, native of China and Eastern Asia. As a conservative measure, trees are not allowed to be cut in countries where they are raised commercially until they are about fifty years old.

Uses. Camphor is used in medicines, as a disinfectant, as a protection against insects, in the manufacture of smokeless powder, and in the manufacture of celluloid. In 1915, the world's supply of camphor was estimated at 10,000,000 pounds, 70 per cent of which was used in making celluloid.

Camphor is not of commercial importance in any part of Africa, but several experiments have given promise of large outcome, especially those in Mauritius.

Sandarack is the gummy product of several small trees or large shrubs (*Thuja articulata*), that grow in northwestern Africa. There are similar species of this resin in other parts of the world, but the African product is by far the best. Its chief use is as a dryer in varnishes.

In 1913, Algeria exported to France, vegetable wax, gums, resins, 5218 tons, valued at \$945,507.

Gum Arabic (*Mimosa nilotica*) occurs as an exudation on the stems and branches of several species of *Acacia* found in Africa. It is soluble in both cold and hot water. It occurs in commerce as rounded lumps of a nearly white appearance.

The ash on calcination is about three per cent., consisting of carbonates of calcium, magnesium, and potassium. Indian gum arabic is of a dark color, and insoluble in water.

Gum Senegal is closely allied to gum arabic, being also obtained from a species of Acacia (*Mimosa senegal*) growing in Northern Africa. It is much darker in color than gum arabic.

In the Soudan the best gum is collected from the gray backed acacia tree, *acacia senegal*, known locally as hashab. A certain amount of gum is collected in the Blue Nile district, and there is a fair gum trade between the Blue Nile and Abyssinia; but Kordofan is the principal seat of the gum collecting industry. In this province the gum is transported either direct to Khartoum by camels or to Goz Abu Guma and El Dulime, towns on the White Nile.

The method of collecting this gum is as follows: The gum exudes from the stem and branches spontaneously, and the flow is usually stimulated by making incisions in the bark. The exuded gum hardens on exposure to the air and is then collected, dried and exported.

Exports of Soudan Gum from Egypt

	Kilos	Value
1885	1,146,879	£ 97,671
1890	7,052	469
1895	149,955	5,856
1900	1,863,072	93,847
1905	8,838,483	217,132

Egyptian export of gum in 1915 was \$94,441; 1916, \$118-, 712.

Morocco exports annually about 100 tons.

The gum industry of **Senegal** is of comparatively recent origin. In 1914 Senegal exported 3,936,347 pounds of gum arabic valued at \$226,000.

A fair amount of gum now reaches this market from Northern Nigeria, the average annual value being about £8,000, and possibilities exist in this direction in the Gold Coast Colony, Orange River Colony and various other parts of Africa.

Gum Senegal is also produced in **Guinea**. Before the war German West Africa's most important export was gum arabic, which amounted to about \$4,000,000 per annum.

In 1912 French West Africa exported 7,255,526 pounds of gum arabic, valued at \$554,162; and in 1913, 7,882,627 pounds, valued at \$481,091.

Gum arabic is a special product of countries bordering the desert, hot dry winds favoring the exudation of gums and resins.

Gum tragacanth (*Astragalus gummifer*), native to Persia and Greece, but introduced into many other countries, is largely used as a substitute for gum arabic.

As gum and resin gathering is such an important **Outlook.** industry in Africa and the natives are so largely depended upon for obtaining it, they should be trained in economical methods and taught the future want that will result from present waste. They should also be taught to grade the gums, in order to bring about the best financial returns. There is an abundance of gum in Africa although the sources of petrified copal must gradually diminish.

Wheat Additional

In 1918, Algeria had 3,186,000 acres in wheat, which produced 49,199,000 bushels. During the war Algeria was one of the large sources of wheat for the Allied armies.

Some 70 or 80 modern flour mills are scattered throughout Algeria, Constantine, and Oran, with a total of 6,000 horsepower, with 1,300 workmen.

During the war Morocco increased the acreage of her wheat fields until wheat became 11 per cent. of the total exports in value, exporting in 1915 wheat to the value of \$1,143,048; in 1916 to the value of \$1,400,000.

Wheat growing is encouraged in the southern and eastern parts of Belgian Congo and in other West African countries. Until recent years nearly all the flour used has been imported.

In 1914, German East Africa exported wheat flour through Lorentz Marques to the value of \$1,314.

In 1915, Mozambique exported wheat to the value of \$219,646.

The wheat output of Rhodesia for 1916 was valued at \$4,500,000; the flour output of Rhodesia for 1916 was valued at \$2,500,000.

INDEX

	Page
Animal Products	17
Wool	18
Mohair	22
Hides and Skins	25
Outlook for Hides and Skins.....	5
Meats	34
Horses and Mules	40
Dairy Products	42
Poultry and Eggs	45
Beeswax and Honey	48
Silk	51
Ostrich Feathers	53
Ivory	56
Sponges	61
Coral and Shells	63
Fish	69
Big Game	75
Mineral Products	83
Gold	84
Diamonds	89
Copper	96
Tin	101
Iron	106
Manganese	109
Chromium	111
Silver	112
Zinc	113
Lead	115
Coal	116
Mica	120
Asbestos	122
Graphite	124
Petroleum	126
Phosphates	129
Potash	131
Salt	131
Soda	133
Natron	133
Limestone	134
Marble	135
Gypsum	135

Talc	136
Chalk	136
Other Precious Stones	136
Minerals of Minor Production	137
Antimony	138
Vegetable Products	141
Vegetable Oils	142
Outlook for Palm Products	6
Olive Oil	147
Cocoanut Oil—Copra	150
Castor Oil	152
Sesame	153
Other Oils	153
Shea Nuts	155
Manioc, Cassava	156
Barley	158
Millet	159
Durra	161
Oats	161
Wheat	162-261
Wheat Additional	261
Rye	165
Maize or Mealies	165
Rice	170
Cotton	174
Outlook for Cotton	6
Sisal	180
Esparto	182
Tobacco	187
Vanilla and other Essences	189
Vegetable Perfumes	191
Rubber	192
Outlook for Rubber	5
Spices	195
Cloves	197
Ginger	198
Herbs	200
Dyes	201
Drugs	205
Sugar	208
Beans	210
Peas	213
Coffee	215

Tea	217
Cocoa	218
Outlook for Cocoa	6
Kola	223
Peanuts Arachides	225
Ground Nuts	226
Nuts	227
Fruits	229
Dates	235
Wines and Liquors	236
Garden Vegetables	239
Woods of Africa	242
Wattle and other Tanning Barks	253
Gums and Resins	256

OF THE
A&P CO.

YC 39284

563312

HF1041

D3
v.1

UNIVERSITY OF CALIFORNIA LIBRARY

